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1922

Root-Canal Therapy. A Symposium —*Skillen, Hatton, Blayney*

Jaw Relationship During Denture Construction—*Wright*

Root-Canal Sterilization—*Marshall*

Abnormal Surface Wear on Teeth —*Bricker*

Dental Education—*Dewey*

Oral Hygiene Lecture—*Edgar*

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Full Lower Denture—*Owen*

Roentgenographic and Clinical Findings —*Eusterman*

Greater Breadth of Vision—*Editorial*

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Vast lobby, with beautiful furnishings and floral arrangements

Paneled ballroom, with a seating capacity of fifteen hundred

Dining-room, three sides of which are nearly all glass, flooding it with California sunshine. Exhibits will be held here

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Original Communications

A DISCUSSION OF FACTORS INVOLVED IN ROOT-CANAL THERAPY

A Symposium Presented Before the Chicago Dental Society, December 20, 1921, by William G. Skillen, Edward H. Hatton, and J. R. Blayney

PERMEABILITY—A TISSUE CHARACTERISTIC INVOLVED IN ROOT-CANAL TREATMENT [1]

By WILLIAM G. SKILLEN, D.D.S., Chicago, Illinois

A GLANCE over the literature, I believe, will suffice to indicate that the settlement of the problem on root-canal treatment is still far off. Medicaments on root-canal filling materials apparently have been shown to fall short of expectations. Sterilization of infected tooth structure has been indicated as difficult to accomplish. Removal of the contents and successful filling of the tortuous ramifications of the canal seem impossible without irritation or destruction of the adjacent tissues. Statistics show that failures occur in so-called "well filled" root canals, as well as in "poorly filled" ones; and we know that many times our most careful efforts fail in the most hopeful of fields, while those of an opposite character seem to succeed. "Shall we, or shall we not attempt to retain the pulpless tooth?" is the question today. In the presence of the irrefutable dictum that the natural organ is better than any substitute, the answer is, "We shall." Even tho we succeed in what Dr. Moorehead has rightfully

[1] Aided by a grant from the Research Commission of the National Dental Association.

called the "anterior problem[2]," an effort which by all means should be more than an effort, that success I believe, will be tempered by human frailties over which we can have no complete control, so that the troubles of the present will still be with us. Therefore, the fundamentals—tissue structure and physiology—are still of extreme importance, so that the subject of this paper—"Permeability—A Tissue Characteristic Involved in Root-Canal Treatment," will not be amiss.

To any reasonable mind it should not seem possible that a tissue of the body is without a nutritive supply or, in other words, is impermeable to the nutritional fluids and hence also to other fluids. All other ideas to the contrary therefore, this fact should stand without proof even tho it were wanting. However, permeability of at least a part of the cementum has been denied, so that I shall attempt to show that what is true of the other tissues of the body is also true of all of the tissues of the root. Whether fluids will pass from one of the tissues of the root into the other, i. e., from dentin into cementum or the reverse, is a question upon which reasonable doubt might be held. But as the reaction and the treatment of these tissues would depend somewhat upon their relation to each other, the question is rather an important one; and so I shall also attempt to show that there is a pathway between them.

Altho it is usually considered that dentin and cementum, especially above the apical region, are separated by a structureless layer of calcified tissue, I have not found this to be the case thruout the entire life of the tooth. In the young teeth of animals, the tubuli seem to extend clear to the dento-cemental junction (Fig. 1) and we may surmise that the same thing occurs in the human because adult human material, in places at least, frequently show the same condition (Fig. 2). The subsequent separation of the two tissues seems to be due to either a complete or a partial obliteration of the tubuli over all or part of the circumference of the root. Possibly, the calcification of the tubuli is more often only partial; the separation, then, is only apparent because the fineness of the tubuli and other spaces tends to render them unobservable. Thus structurally there would appear to be very often a pathway between dentin and cementum in the middle and gingival thirds of the root.

In the apical region, however, that heterogeneous arrangement of cementum and dentin which seems to exist almost from the beginning, appears to remain unchanged, altho quite often augmented by subsequent absorptions and repairs in which areas of dentin are replaced by cementum. Hence, at least in the structural characteristics of this region, we have every evidence of a frequently existing pathway between the two tissues, concerning which there is practically no dissension in the literature.[3] Furthermore, the cellular character of the cementum in this region precludes any possibility of its not having a circulation; and the permeability of the dentin not being questioned, there is then every possibility of an interchange of fluids between the two.

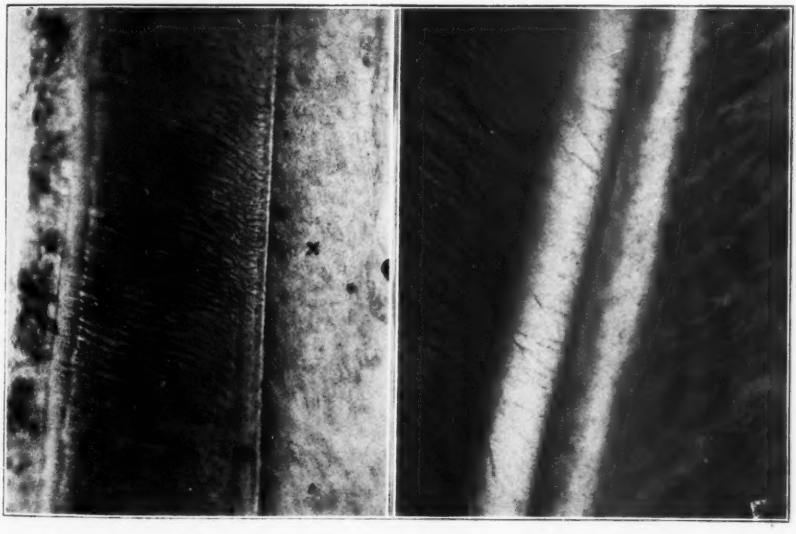
Any more actual evidence of the permeability of these tissues than that of a structural nature seems difficult to obtain. Only one worker[4] appears to have had any success in this direction, and as far as I know that evidence is not at present available. Two contributions of a negative character appear in the literature. Only one of these which is an attempt to stain the cementum from the pulp chamber in vacuo, seems to carry

[2] *Jour. Nat. Dental Assoc.*, July, 1921.

[3] J. Howard Mummery, *Microscopic Anatomy of the Teeth.*

[4] Harold K. Box, D.D.S., Toronto, Canada.

any force.[5] The other[6] experiment in which the author removes the cementum from the dentin by decalcification, thereby disclaiming the existence of any connection between the two tissues, becomes nil in the light of the structure and development of dentin and cementum. Furthermore, if cementum can be shown to be porous, and it abuts upon the tubules, or granular layer, or even



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Figs. 1 and 2.—Fig. 1, shows relation between tubuli and forming cementum in young tooth of dog, X is peridental membrane, cementum (Thionin). Fig. 2, shows relation between tubuli and cementum, gingival region, human tooth (Thionin).

porous matrix, of the dentin, there is nothing to prevent fluids passing from one tissue to the other even if it were true that there is no fibrillar continuity between them as the author believes. During the past year I have tried in many ways to obtain additional facts, but because of unforeseen difficulties I have had only partial success. It is to the results of this part of the experiment that I wish to direct your attention in the belief that it demonstrates quite fully, not only the permeability of all parts of the cementum, but also that there may be a continuity between it and the dentin.

Sometime ago we published[7] a method for staining cementum and dentin by infiltration of the tooth, either extracted or in situ, the stain being retained during the subsequent process of decalcification and sectioning, thus possibly assuring us of a natural picture of conditions. The results of this method have been alluded to once or twice since that time.[8] Aside from the structural picture

[5] John S. Marshall, *Items of Interest*, XLII, (1920), p. 39.

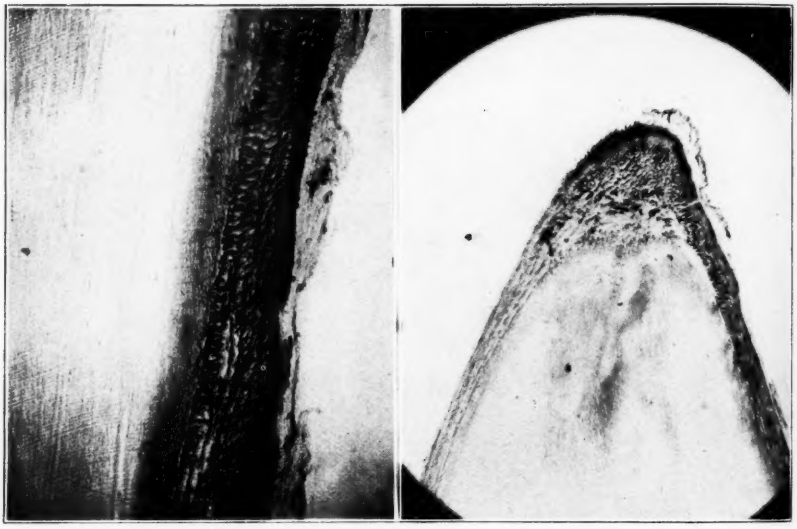
[6] John A. Marshall, *Jour. Nat. Dental Assoc.*, VIII, (1921), p. 300.

[7] *Dental Cosmos*, June, 1920.

[8] *Jour. Nat. Dental Assoc.*, VIII, (1921), pp. 3, 621.

obtained by this method of staining (a picture which is impossible to describe wholly at this time, but which seems to indicate that dentin as well as cementum is far more porous than has been heretofore thought, and therefore permeable) it also indicates that these tissues are directly or indirectly connected so that fluids might pass from one to the other.

dried out in a flame and then painted with paraffin or balsam to prevent the stain from flowing into the canal. The teeth were then imbedded in molten paraffin so that the crowns were covered about to the gingival line with the paraffin. This left about two-thirds of the root exposed to the stain which was poured over them. Subsequent exami-



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Figs. 3 and 4 illustrate permeability of cementum and dentin.

It certainly should seem clear that the penetration of the stain is due to the porosity of the tissues, and that the area in which the stain has lodged is the pathway by which it gained access. However, as infiltration has taken place from all parts of the tooth at one time, actual evidence of its ability to pass from one tissue into the other is uncertain. The work which was undertaken, therefore, was an attempt to remove this doubt.

Teeth were selected that showed no visible defects. The apices of these were

nation of sections obtained showed many faults that had been overlooked and which marred the accuracy of the results. These specimens therefore, had to be discarded so that out of many teeth tested but few served the purpose. In many cases the sealing of the apex did not prevent a backing-up of the stain in the canal so that these specimens had also to be discarded; in fact, all specimens were discarded which showed the least indication of the stain having penetrated from the canal. In no case did

the sealing of the apex prevent this part of the cementum and dentin from being stained.

The results obtained indicate that fluids outside of the tooth may penetrate the cementum and pass into the dentin. With its passage from the canal fairly well blocked, and barring the accidents mentioned above, the passage of the stain into the dentin apparently must have taken place thru the cementum. It is of considerable interest, too, that penetration seems to have taken place thru that part of the root which may usually be considered impermeable from the structural standpoint, namely, the gingival region (Fig. 3). A study of the material indicates that penetration of the cementum has been rapid and thoro, a week or two of time making no appreciable difference. This would indicate that cementum is extremely porous. From the dento-cemental junction into the dentin, the process seems to be slower altho progressive, the amount of dentin affected and the depth of the staining increasing with time. In no instance except at the apex has the stain penetrated the dentin very far. This is a matter of time. If the specimens are left too long, invariably there will be a backing-up of the stain in the root-canal. Until some means is obtained, therefore, for thoroly sealing the apex, we will not be able to carry the experiment to the desired point.

Fig. 5, illustrating permeability of cementum and dentin where the former was exceptionally thick.

The backing-up of the stain from the apex, and the staining of the apical tissues in spite of the sealing, however inefficient, is of interest. This would tend to show that the apical region is very permeable, more so even than the structural picture would indicate. In every case, all of the cementum and dentin were stained, the former just as deeply as that on the uncovered part of the root (Fig. 4). This even occurred when the apex was not completely covered with the stain. This feature is significant in view of the probability that the apical region is chiefly the vulnerable point in root-canal treatment.

It would seem then from both the structural and experimental standpoint, that the continuity and permeability of the tissues of the root more than promise to become established. In view of this, therefore, and especially since root-canal treatment at the present time, is surrounded by uncertainty, this feature should be considered as one of the fundamental characteristics of the tissues of the root to be given due consideration in meeting the problem before us.

THE POSSIBILITY OF APICAL REGENERATION AFTER ROOT-CANAL FILLING FROM THE HISTOPATHOLOGICAL POINT OF VIEW[9]

By EDWARD H. HATTON, B.L., M.D., Chicago, Illinois

THE apical portions of the pulp canals of teeth with partial fillings, in the absence of infection and where the distance is not too great, are occupied by living pulp tissues or are more or less completely obliterated by calcified structures. In many instances living pulps are found in canals greatly reduced in size by various forms of calcification. The foregoing statements are based on the examination of teeth which had partially filled pulp canals and in which the apical end of the filling material did not reach to the junction of the cementum and dentin by at least 3 mm. In most cases such changes extended to and were in contact with the apical end of the pulp canal filling altho in a small number there seemed to be an intervening empty space. These teeth were extracted because of infection at one or more roots, because of infection of the adjacent gingivae or of the peridental membrane, and because of prosthetic reasons. The greater number represents clinical failures and the evidences of regeneration and restoration of the apical region under such circumstances are much more remarkable.

Grove,[10] in 1916 anticipated such conditions saying: "The question now confronts us, what shall be done with these tissues when the pulp tissue is *devitalized*" (italics mine). My opinion is that by proper treatment this tissue could become obliterated and cementum formed to close the canals, or perhaps, in some cases, at least, the tissues would remain vital indefinitely.

There is abundant clinical evidence that changes do take place about the apices of teeth with filled pulp canals, which changes interpreted by roentgenograms and the absence of clinical symptoms of infection or tissue destruction are certainly constructive. Black's[11] thoro analysis of a large number of teeth with pulp canal fillings includes a large number of such restorations. Duke[12] Merritt[13] and many others have added to such clinical evidence. A considerable number of these concerns instances in which the pulp filling did not reach to the junctions of the apical cementum and dentin or in which roentgenographic evidence of a previous periapical infection had vanished after treatment and the insertion of a pulp filling.

Grove[14] found deposits of secondary cementum and living pulp tissue in the pulp canals of teeth partly filled canals, and I[15] have described these and other changes in such teeth. Since the changes there described concern both the soft and hard tissues as well as their relationships, only such technical methods of study as preserve both of these tissues in the histological preparations are at all to be depended upon in arriving at

[9]From the Research Laboratories of Northwestern University Dental School and the Chicago College of Dental Surgery, and partly supported by funds supplied by the Research Commission of the National Dental Association.

[10]*Dental Cosmos*, LXIII, (1921), 968.

[11]*Jour. Nat. Dental Assoc.*, VIII, (1921), 132.

[12]Duke, *Oral Sepsis in Its Relationship to Systemic Disease* (St. Louis, 1918).

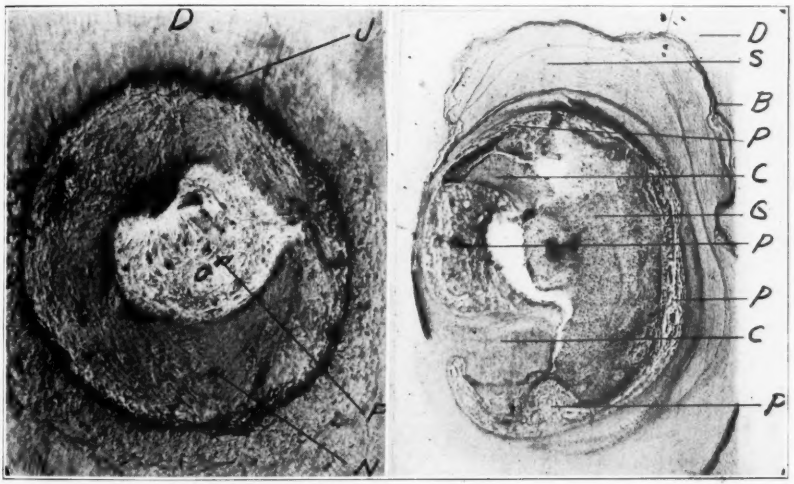
[13]Merritt, *Jour. Dental Research.*

[14]*Jour. Nat. Dental. Assoc.*, IX (1919), 763.

[15]*Jour. Amer. Med. Assoc.*, 77 (1921), 1805.

the truth. Such a method is described in this same article especially suited to the rapid and exact examination of structures containing both hard and soft tissues, which method has been used in the preparations of the sections from which the following illustrations have been made.

Figure 1 is a photograph of a transverse section of one root of a molar tooth extracted from a forty-five-year-old woman because of infection about an adjacent bicuspid and the friability of the crown. The other two roots were the seat of a chronic infection (histological examination). This section was taken from a level approximately midway between the apex and the apical end of the filling, stained with hematoxylin and eosin, and photographed on an orthonon plate thro a 16 mm. apochromatic objective and a green gelatin light filter. The pulp canal is greatly narrowed by a rather amorphous calcified shell within which is contained a pulp different in no essential respect from pulps found in the apical portions of adult unchanged teeth, except perhaps for the absence of an odontoblastic layer. The character of the vessels, the pulp cells, and the arrangement are all quite definitely those of adult apical pulps. Tho not stained for nerve tissue, there seem to be nerve fibres present in this section. Since the diameter of the pulp canal containing the gutta-percha cone is also narrowed by a shell of secondary calcified material, it is assumed that much of the deposit of calcified substance occurred before the pulp filling was inserted. Such pulps are the undamaged or only partly destroyed pulps of the apical portion before filling.



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Figs. 1 and 2.—Fig. 1: D, dentin; J, junction of the old pulp wall; N, the secondary calcified shell; P, pulp. Fig. 2: C, calcified material; D, dentin; S, calcified shell within (B) old pulp wall; G, gutta-percha cone; P, pulp.

Figures 2, 3, and 4 are all transverse sections taken from one root of a molar tooth, the fused second and third roots of which had a small apical granuloma. All were photographed from sections

prepared and stained like Figure 1, except that Figure 3 is a high power magnification (4 mm. apochromatic objective). Figure 2 was made from a section taken from the level of the apical end of the filling, within a pulp canal reduced by secondary calcified material. Here is a strangely arranged assortment of gutta-percha, flakes, spicules and sheets of calcified material, and pulp. The pulp is not in one mass but does occupy all the space, however small and however shaped, not filled by either the gutta-perhca or calcified material. Figure 4 is a highly magnified photograph of a small arm of the pulp tissue adjacent to a gutta-percha cone and separated from it by a very thin sheet of calcified material; the tall cells at this junction surely are some form of calcium forming cells, cementoblasts, osteoblasts, or atrophied odontoblasts, probably the first named. Figure 3 was taken from a level just at the apex, where there are two small foramina not much larger than is necessary to admit the blood vessels contained within them. Judging by the diameter of the pulp at these levels and that of the gutta-percha filled portion one must assume that most of the calcified shell here illustrated was formed after the pulp filling was inserted.

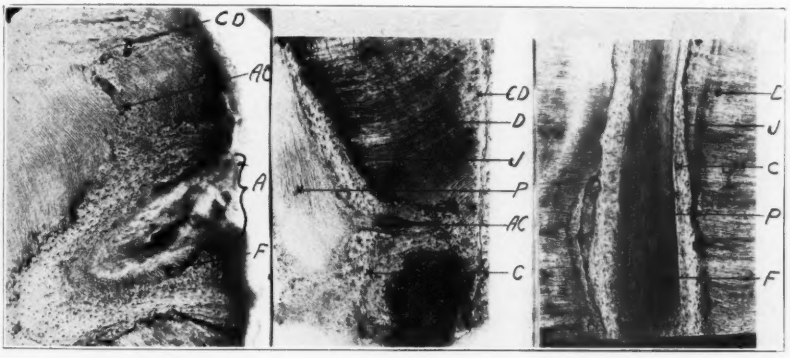
Figures 5, 6 and 7 are all photographs of longitudinal sections of one apex of a bicuspid tooth taken thru a green gelatin light filter on panchromat plates using a 16 mm. apochromatic objective. These sections were all stained with thionin (I cannot recommend all grades of thionin for this purpose. The Grübler and Heyl stains have been found absolutely dependable) and picric acid. (This is a most satisfactory differential stain for hard tissues apparently first used by Schmorl in staining bone, and therefore named from him. Guido Fischer described and used this stain in the preparation of many of the colored

3 4

Figs. 3 and 4.—Fig. 3: P, small pulp foramina; D, dentin. Fig. 4: G, part of gutta-percha cone; N, newly formed calcified material; P, arm of pulp with calcium-forming cells; S, shell of calcified material on pulp wall.

plates in his *Bau und Entwicklung des Mundes.* I wish to urge the adoption of this staining method by all dental histologists and pathologists both for class-work and research purposes). In all of these sections the pulp is contained within a canal greatly narrowed by deposits of secondary osseous cementum which has accurately filled ancient erosions in the wall just as if poured into them like concrete or plaster. The reduction of the diameter of the pulp chamber extends apexward from the junction of the filling and the pulp, and is not found crownward from this level; it is assumed on this account that this reduction took place entirely after the root filling was put in place. The cellular structure of the pulp is not distinct because of the stain used, but the course of the vessels and the fibrous network of the pulp is quite clear. Particular attention is called to the insertion of the fibers of the pulp into the calcified pulp wall in all essentials like that of the insertion of the fibers of the peridental membrane into the cementum covering the outside of the root. The finer details of the cementum may be seen in the high-power examination of such slides (see Fig. 2 of my article previously quoted). Such teeth are examples of periapical infections with regions of absorption that have healed under treatment with regeneration of the apical region after pulp canal filling.

Grove believes that the pulp instead of projecting into the apical peridental membrane ends at the level of the junction of the apical cementum and dentin. This seems to agree with Skillen's[16] interpretation of the genesis of the apical structures. Recently a number of preparations have gone thru my hands in which the apical peridental membrane is seen to project into the apical opening of the pulp chamber of teeth with partly filled pulp canals in the form of a very definite bud-shaped structure, even beyond the junction of the apical cementum and dentin. It is on such findings that I venture to assume that this projection of peridental membrane has pushed itself up to the apical end of the pulp canal filling in such preparations as have been shown in this paper.



5 6 7

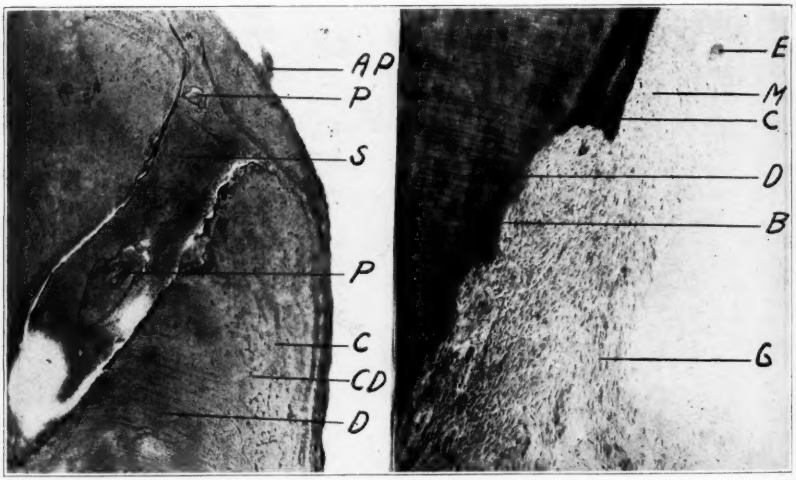
Figs. 5, 6, 7.—A, apical opening of the pulp canal; AC, accessory apical pulp canal; C, cementum; CD, junction of cementum and dentin; D, dentin; F, fibers of new pulp imbedded in the new cementum; J, old pulp canal wall; P, pulp.

[16] *Jour. Nat. Dental Assoc.,* January, 1921.

Cementoblasts have been carried along with this projection. No other explanation at this time can be offered that accounts for all these facts and the perfection of the structural detail in the shell of osseous cementum lining the walls of these apical pulp chambers.

Figure 8 is a longitudinal section of the apex of a tooth with a partly filled pulp canal in which the apical pulp canal is filled with a calcified core in the heart of which is a tiny filament of soft tissue, this core occupying that portion of the canal between the apex and apical end of the filling. This was photographed thru a green light filter using a 16 mm. objective from a section stained with thionin and picric acid. Such calcified cores are not as common as was anticipated and when found frequently contain a slender filament of pulp cells and a vessel in the center of the core.

Unfortunately reconstruction and regeneration do not always take place. Infection with destruction of the apical region is frequent and is the most serious accident that occurs as a complication of root-canal treatment and filling. These retrograde changes are so frequently associated with absorption of both the apical end of the tooth and the alveolar process that a few figures illustrating the steps in such a process are probably not out of place in this discussion.



8 9

Figs. 8 and 9.—Fig. 8: AP, apical pulp; P, pulp filament; S, calcified pulp core; C, cementum; D, dentin; CD, junction of the cementum and dentin. Fig. 9: E, epithelial cord; M, peridental membrane; C, cementum; D, dentin; B, irregular border where absorption is taking place; G, granuloma capsule.

Figures 9, 10 and 11 are photographs of hematoxylin and eosin stained sections of teeth undergoing absorption. In a longitudinal section of an infected apex (see Fig. 9) absorption has taken place from the junction of the capsule of the root granuloma surrounding the apex with the fibers of the unchanged peridental membrane apexward. Definite

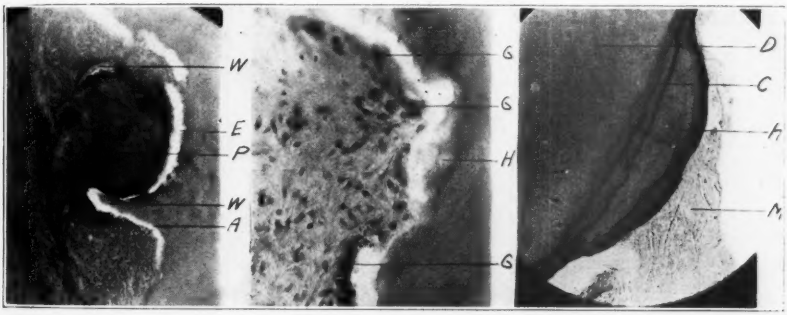
cell structures lie in close approximation to the serrated edge of the dentin and cementum where absorption is taking place. I have never seen absorption except where certain definite kinds of cells lie approximated to the hard tissues which are being absorbed; this is very definitely illustrated in Figure 10, a transverse section of a root apex with a necrotic mass in the pulp cavity. There is no evidence of any absorption from within; on the contrary absorption is taking place entirely from the periphery of the tooth where living cells lie in close contact with the hard structures. Figure 11 is a high-power (4 mm. apochromatic) photograph of the cells lying close to the calcified structures in a place where typical absorption is going on.

Another form of calcification is illustrated in Figure 12 a low-power photograph (16 mm. apochromatic objective) of a longitudinal section of the apex of a tooth surrounded by a so-called granuloma. In this case at the junction of the fibers of the normal peridental membrane and the fibers of the capsule there is a button shaped thickening of the cementum. The reaction at this point to the irritation of the apical infection instead of producing absorption as shown in Figure 9 has resulted in just the opposite. Possibly it may be assumed from this and the foregoing illustrations that exposure to a concentrated toxic irritation inhibits all cellular response and and causes cell death; a middle degree of irritation with absorption under cellular action; and a mild degree with a stimulation of the calcium-forming structures.

It is not wise to generalize extensively from a few examples like the preceding; the number is too small and they are not closely related to clinical procedures. Nevertheless the following statements are ventured:

1. That infection of the apical region of teeth either with intact pulps or pulp canal fillings is a most serious accident is emphasized in a new way, for in the presence of infection all attemps at regeneration are doomed to failure.

2. These studies demonstrate that restoration of the apical region from the end of a pulp filling apexward is a distinct and definite possibility and that such a restoration may not be any more susceptible to infection or reinfection



10 11 12

Figs. 10, 11, 12.—Fig. 10: W, part of pulp wall not yet absorbed; P, necrotic mass of pulp; E, pulp wall of side opposite the absorption. Fig. 11: G, giant cells (osteoclasts); H, Howship lacunae. Fig. 12: C, cementum; D, dentin; H, button-like region of hypercementosis; M, junction of the granuloma capsule and the peridental membrane.

than scar or regenerated tissue elsewhere in the body.

3. Because the smaller accessory foramina react in all respects like the principal ones, the assumed risks of inserting pulp canal fillings into canals with tortuous accessory or terminal foramina may be considerably discounted, and root-canal filling need not, therefore, be condemned because all accessory canals and the apical portion cannot be reached.

4. It is not wise, however, to assume that the partial filling of pulp canals is a safe and justifiable routine procedure. The junction of the cementum and the dentin of the apex is the ideal termination of such a filling.

5. Such regenerations as the preceding must be greatly hampered by unnecessary injury of the apical structures by instrumentation or the corrosive action of many drugs used in root canals. A rigidly aseptic, gentle and accurate root-canal technic should favor these restorations.

THE CLINICAL RESULTS OF PULP TREATMENT

By J. R. BLAYNEY, D.D.S., Chicago, Illinois

MY PART is to present some of the results obtained from the clinical studies of pulp treatment, particularly as pulp treatment is related to the periapical tissue; also to describe the methods employed in recording the case histories, both at the time of treatment and when making subsequent examinations.

There should be co-operation between the laboratory and clinical practice. The clinical methods in vogue should be in accordance with laboratory findings, and the results of laboratory research must finally rest upon clinical practice.

A. D. Black (2) calls attention to the facts that we have neglected to compile our case histories of pulp canal work; and that we have failed to present records of cases to substantiate opinions. In the fall of 1918 we decided to keep a definite record of every pulp and root-canal treatment carried on in the dental infirmary of the University of Illinois, and at present we have in our files over fifteen hundred histories of root-canal treatment. The purpose of compiling these case histories is to afford material for futher study and to have a permanent record so we may check the results of our clinical methods.

All of the patients are invited to return at intervals ranging from one to six months, in order to have radiograms made of the tooth or teeth that we have treated. Since we are dealing with a different type of patient from those one has in his office, it is impossible to follow all the cases, and at times this is most discouraging, as often an interesting case fails to return for re-examination. We attempt to follow every case treated so our study will not be confined to a few selected cases or to a certain type of treatment.

All of the treatment was carried on under strict aseptic precautions so we believe that the factor of bacteria gaining entrance from the outside has been reduced to a minimum. This is a very important factor, and some definite routine method of establishing and

maintaining asepsis during treatment must be worked out before the operator can hope to find his cases successful in the main. It is only by the collection of laboratory investigation and the careful compiling of clinical case histories that the ultimate status of root-canal treatment can be determined. It is because of the lack of a standard root-canal technic together with indifference as to collection of material for a thoro survey and check on clinical procedure that we find such difference of opinion regarding the success of root-canal operations.

Diagnosis

When endeavoring to collect such data it is most important that a corret diagnosis of all the tissues concerned be made and accurately recorded so that upon a later date you may refer to the history and have ample proof as to the exact condition of the pulp or canal, and the periapical tissue, before treatment was undertaken (Fig. 1). For instance it is of utmost importance when following a case of pressure anesthesia to know if the pulp was exposed by caries or an accidental exposure during cavity preparation under a rubber dam. We also suggest that a radiogram be made in all cases prior to pulp removal in order that an exact record may be obtained of the periapical tissue. This same radiogram will serve as a guide in opening the canal as it will show the general direction, the number, and size of the roots.

The general health and age of the patient should be recorded as both of these factors have an important bearing on the outcome of the case, and such facts should be taken into account when making a survey of material. We can appreciate their value to the fullest extent because during the first year of our work this information was omitted, much to our regret. These detail items are presented here in an endeavor to help those interested in such a plan over some of our stumbling blocks. Irons (5) calls our attention to the fact that not only should the condition be recorded about which the patient complains but "other portals of infection" should be considered before the final procedure is determined, and he again says that "the teeth should not be obliged to bear all the odium of primary sin."

Methods Used For Removal of Vital Pulps

In removal of a vital pulp we have used pressure anesthesia by cocaine, some form of local anesthesia, i. e., block, infiltration or intraosseous, and in a very few cases arsenic. The method of choice has been cocaine pressure in all teeth except molars, where we employed nerve block in lowers and infiltration or intraosseous in uppers.

This past summer in reviewing the material collected during the last three years, we were surprised to find such a large percentage of our pressure cases with rarefied areas around the root ends, to be exact 52 per cent of all the pressure cases were involved regardless of the character of the root filling (Fig. 2). It is to be borne in mind that all cases were examined critically, and if the radiogram showed only a slight thickening of the apical peridental membrane it was classed as involved. Only a small percentage of these cases demand the removal of the teeth. To repeat, I may say there is a very wide range in the degree of tissue destruction, since every case that showed evidence of the slightest tissue change, up to the formation of a granuloma has been placed in the involved group.

In an effort to find some explanation for the large percentage of involvements a careful study of each case history was begun, and after much time had been spent we devised the following plan. All cases were classified as to the condition of the pulp at the time pressure was applied. In one group were placed those in which the pulps were normal or where the exposures were accidental, and made

DENTAL PULP CASE HISTORY

Name **Age** **Date**

Address **File No.**

Tooth		Diagnosis										Pulp Removal				Treatment						Sealing		Root Filling					Sub. Ex. by Rad.					
		Pulp					Periapical Tissue																											Color
Right	Left	Vital Normal	Vital Hyperemia	Vital, Caries	Grangene	Old R. F.	Normal	Acute Abscess	Granuloma	Liquefac. Necrosis	Infection Cyst	Color	Press Anesth.	Infiltration	Nerve Block	Arsenic	Essential Oil	Cresol	Creosote	Iodin	Di-chlor. T	Cement	Guttapercha	Guttapercha	Chlor. P. & G. P.	Inaccessible	Good	Under Filled	Over "	Bone Normal	Bone Involved	Improving	Uncertain	Normal	Discolored
Student's Name																																		
Remarks																																		

Fig. 1.—Envelope for filing case histories and X-ray films, recording diagnosis method of pulp removal, drugs used in treatment, classification of root filling and the condition of the periapical tissue at subsequent examinations. The use of an envelope quite similar to this was first suggested by Arthur D. Black, Chicago.

1. Enter name of patient, address, age, and date.
2. Indicate tooth treated by number (upper) or letter (lower).
3. Diagnosis divided into (A) diagnosis of pulp, (B) diagnosis of periapical tissue.
   - A. Diagnosis of pulp: If pulp is vital and normal and is covered by a layer of sound dentin mark X in first column. If pulp is vital but inflamed mark X in second column. If pulp is vital and exposed by caries or if decalcified dentin has reached pulp mark X in third column. If pulp is dead mark X in fourth column. If canal has previous root filling mark X in fifth column.
   - B. Diagnosis of periapical tissue: This is chiefly determined by radiographic evidence. In all cases a radiogram is taken before treatment is undertaken. If radiogram shows tissues normal mark X in first column unless clinical symptoms are those of acute abscess, when X is placed in second column. When radiogram shows destruction of tissue around root end and a fistula is not present mark X in third column; if fistula is present mark X in fourth column. If radiogram shows the presence of an infection cyst mark in proper column: Note color of tooth in that column.
4. Method of pulp removal: If pulp is anesthetized by cocaine pressure infiltration, or nerve block so indicate in proper column or if arsenic has been used to destroy pulp enter X in that column.
5. Treatment: Each horizontal line represents a sitting; enter date of each sitting at left margin and check square under the drugs used. The individual dentist may modify list of drugs to suit his ideas.
6. Sealing treatment: Mark X in proper column.
7. Root filling: Place X in first or second column to indicate if gutta-percha alone or if chloropercha and gutta-percha were used as root filling material. If canal is inaccessible indicate in that column. Have radiogram made after root is filled and record character of filling (good, under, over).
8. Subsequent examination: The case is to return about every six months for radiogram after which date is entered in column indicating the condition of the periapical tissue at that time. The color of the tooth should be noted each time patient returns.
9. Remarks: Some brief statement should be made as to the general physical condition of the patient.

Tabulation Showing the Results of Cocaine Pressure for the Removal of Vital Pulps.

Number of cases treated	479
Number of cases followed	93
Number of cases periapical tissue normal	45 or 47.8%
Number of cases periapical tissue abnormal	48 or 52%

Classification of Root-Canal Fillings

NORMAL		ABNORMAL	
Number of teeth with normal root-ends	45	Number of teeth with diseased root-ends	48
Total number of canals	68	Total number of canals	69
Number of canals with perfect fillings	13	Number of canals with perfect fillings	14
Number of canals with overfillings	18	Number of canals with overfillings	24
Number of canals with underfillings	37	Number of canals with underfillings	31

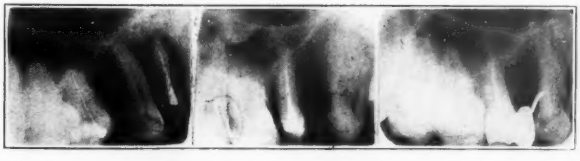
Compiled by the Department of Therapeutics University of Illinois

Fig. 2

after the dam had been applied (Fig. 3); in another group, those with pulps exposed by caries. When the results were tabulated we found practically all of those in the first group had a healthy root end, and when they did not it was usually due to mechanical injury. After the results in the second group were compiled an effort was made to find why some of them were normal and it was found that in some cases a dressing of oil of cloves or phenol compound had been sealed in the cavity from one to two days prior to applying the pressure (Figs. 4 and 5).

Dr. Black (3) tells us that a pulp exposed by dental caries is an infected pulp, so when we use pressure anesthesia on an exposed pulp without first sealing in a mild antiseptic for at least twenty-four hours we merely force the infection along with the cocaine, some of which will pass into the periapical tissue (Fig. 6). Another point which is too often overlooked is the necessity of removal of all carious material from the cavity before applying pressure. We have made it a rule where the pulp is exposed by caries and immediate removal is necessary to use some form of local anesthesia rather than cocaine pressure; also first to apply a dressing of some mild antiseptic for at least a day, before using pressure except when the exposure is made by an instrument after all caries has been removed and the rubber in place.

Another problem which we have in mind but at present do not have the



A B C

Fig. 3.—Case with normal pulp covered by sound dentin. Rubber dam applied, field sterilized and exposure made with sterile instrument. No antiseptic sealed in cavity. Pulp anesthetized by cocaine pressure. Patient twenty-five years of age. A, film with measurement in place; B, film immediately after root filling was made; C, film made one year later.

data to verify contentions, is: What effect does cocaine hydrochloride have upon the periapical tissue? Of course it is understood that the ideal is to force the solution just to the foramen and not thru but how often does this occur, and what is the effect upon the periapical tissue. We are conducting experiments upon laboratory animals but have nothing conclusive at present. This thought is mentioned in the hope that it will interest someone enough to attack

A B C

Fig. 4—Pulp exposed by caries. All carious material removed and dressing of oil of cloves placed directly over exposure for forty-eight hours. Pulp anesthetized by cocaine pressure. A, radiogram with wire measurement in place; B, radiogram immediately after root filling; C, radiogram of case eighteen months later.

especially when the operator is striving to remove the pulp without pain to the patient. Cocaine is a protoplasmic poison and "whenever a 5 per cent solution is injected hypodermically, it may result in the death of tissue, which shows either as a necrotic area of the skin or a sterile abscess" (1). Often an operator will use 2 or 3½ grain pellets of cocaine dissolved either in the drop of blood oozing from the exposed pulp or on a small pellet of cotton moistened with sterile normal salt solution. I am wondering what concentration we have when this is forced into the tissue fluids of the pulp, this problem, also to show what questions will arise when surveying a group of case histories. From now on we will not teach that cocaine pressure is the method of choice to anesthetize a vital pulp, and when pressure is necessary we will use a stock solution of cocaine of a strength not over 4 or 5 per cent. It is also suggested that novocaine should be used in a series of cases for comparison.

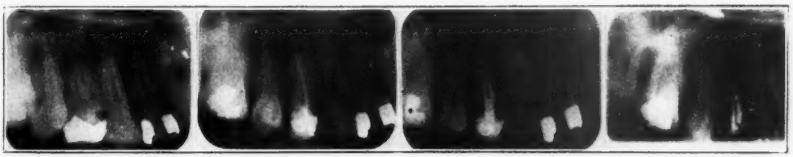
A B C D

Fig. 5.—Pulp covered by carious dentin. Pulpal abscess in patient fifteen years of age. When removing carious material the mesial horn was exposed where a small amount of pus was found. Sealed Buckley's phenol compound was placed directly over exposure and sealed for two days. Pulp anesthetized by cocaine pressure. A, film with wire measurement immediately after pulp removal; B, film immediately after root filling; C, first follow-up six months later; D, third follow-up eighteen months after root filling.

Treatment of Teeth With Periapical Involvement

Some authors have repeatedly advised that all teeth with periapical disturbance should be removed. We have

not followed such extreme measures but have attempted to determine, if possible, what types of cases were amenable to treatment, and if so what method of treatment would be most successful. At the outset I would like to make a few qualifying statements. We have not attempted to save many upper molars on account of their close proximity to the maxillary sinus, since so many cases of chronic maxillary sinusitis are associated with infected root ends of upper molars; and second, we have felt we were justified in treating some of these cases from the standpoint of experimental therapeutics. We are not recommending that you should treat in your offices all of the cases discussed here; however, we do not believe it is necessary to extract all teeth with root end infection, provided the patient does not complain of symptoms associated with chronic focal infection. All such cases must be followed with radiograms to determine the condition, in order that the tooth may later be removed should it not respond to treatment.



A B C D

Fig. 6.—Pulp exposed by caries, rubber dam applied, and pulp anesthetized by cocaine pressure without first sealing dressing of some mild antiseptic. A, radiogram of case before treatment (periapical tissue normal); B, canals inaccessible, measurement wires in position; C, radiogram immediately after root filling; D, radiogram of case eight months later (granuloma).

In the past three years we have treated 363 cases with root end involvement of which we have been able to follow 104 cases. Of those we were able to follow 66 cases or 63.45 per cent have either apparently healed or show marked improvement according to radiographic and clinical evidence, while only 36.54 per cent failed to show improvement. Surely if percentages mean anything we cannot subscribe to the doctrine of removal of all pulpless teeth. The treatment of any tooth that falls in this class is based upon the premise that the fibers of the peridental membrane, which are attached to the cementum, are still vital. Noyes (6) tells us that when an infection passes from the pulp to the surrounding tissue "it does not spread along the surface of the root—but passes out between the fibers following the course of the vessels especially the lymphatics," and that the first inflammatory area is in the portion of the peridental membrane nearest the bone, toward which it spreads more rapidly. Again we find the same author (6) says: "Even when these areas of inflammatory reaction become extensive, the surface of the cementum is the last area upon which these tissues are destroyed."

Description of Technic

The treatment of root canals may be divided into mechanical and chemical therapeutics. The description of mechanical procedures is not in the scope of the paper, except that in the discussion of the medicinal treatment it is presupposed that all of the pulp material and softened dentin along the sides of the canal have been removed.

In the selection of a drug to sterilize the canal one should always be mindful of its effect upon the periapical tissue should it escape thru the apical foramen. Coagulating drugs will destroy the vital

fibers that are still attached to the cementum, and which are essential for success. In the past strong disinfectants have been sealed in the canal, and even in some cases forced thru the foramen, in an effort to sterilize the infected dentin. Regarding this Dr. Prinz (7) writes as follows: "Asepsis of an infected dentin root canal can be temporarily established by applying mechanical and chemical measures, but complete sterilization of the entire tubular structure of the dentin in a tooth in situ, is impossible with methods at present in vogue." The selection of drugs to be applied in a root canal should be in accordance with the following statements made by Dr. Prinz (7).

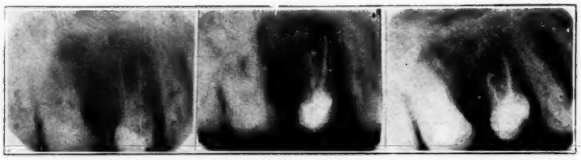
"1. The agent must be able to develop the highest degree of antiseptic power without doing harm to the periapical tissue.

"2. It must maintain its activity for at least twenty-four hours when sealed into the root canal.

"3. It must not cause pain.

"4. It must not discolor the tooth structure."

In all suppurating cases the following procedure was used after the pus had been evacuated and the acute symptoms subsided. The pulp chamber was thoroly opened, the canal brought into view, and the cavity freed from carious material, followed by a dressing of cresol (U.S.P.) placed on the floor of the pulp chamber and sealed without pressure. In twenty-four hours the tooth was opened and the contents of the pulp canals removed, care being taken not to force pulp debris thru the foramen. The moisture was absorbed with paper points and the canal coated with dichloramine-T by means of a pumping motion and warm air, then a paper point moistened with dichloramine-T and sealed in the canal for from twenty-four to forty-eight hours. This treatment is continued until the dressing is found to be free from discoloration, to be reasonably dry, and to have a strong oder of chlorine. Dichloramine-T is a lymphogague so that after several treatments the canal is usually found to contain lymph, which will subside by placing a dry sterile paper point in the canal for about forty-eight hours.



A B C

Fig. 7.—Liquefaction necrosis. Case treated with cresol followed up by tincture of iodin and beechwood creosote. A, radiogram of measurement wires; B, radiogram immediately after root filling; C, radiogram two years after treatment.

In chronic cases with a granuloma or liquefaction necrosis the use of a limited amount of tincture of iodin and beechwood creosote has been most effective (Figs. 7, 8, 9). In these the first treatment is the same as in the suppurating cases. After the canals are cleaned tincture of iodin is pumped into the canal and a droplet is carried thru the foramen, as iodin has a beneficial action upon this granulating tissue, (8). The surplus iodin in the canal is dried and a paper point charged with equal parts of iodin and beechwood creosote sealed in the canal for two or three days. It may be necessary to repeat this treatment a few times, but we do not believe

in extended treatment of these conditions. If the case does not respond in about four sittings, extraction is advised. In using beechwood creosote it should be borne in mind that this is a coagulating agent and must not be carried into the soft tissue. I will show a few results obtained by the above treatment.

A B C

Fig. 8.—Granuloma, tooth treated three years before case came into infirmary. Case treated with cresol, and tincture of iodin and beechwood creosote as outlined above. Sulphuric acid used in effort to reach foramen. A, radiogram of case as it presented for treatment; B, radiogram of case one year after treatment; C, radiogram eighteen months after treatment.

Root-Canal Fillings

"The ultimate purpose of filling root canals is to completely fill them and to maintain a healthy periapical tissue," (4). The filling material should have the following qualifications, as outlined by Coolidge:

"It should be plastic so as to be easily manipulated and carried into all parts of the canals.

"It should not be irritating to the periapical tissue.

"It should not absorb moisture.

"It should be a nonconductor of thermal change.

"It should not be soluble in the tissue fluids of the body.

"It should not shrink or change form after insertion.

"It should be opaque to the Roentgen ray."

We have divided our fillings into three groups, namely, good, over, and underfillings, in an effort to arrive at the relative merits of each. During the second semester of this last year we treated 252 teeth with a total of 459 canals. Of these, 333 canals or 72.5 per cent were opened to the foramen, while the remaining 126 canals were inaccessible. In the filling of the canals that were opened to the end we obtained good fillings in 44.44 per cent, overfillings in 39 per cent, and underfillings in 15.84 per

A B C

Fig. 9.—Liquefaction necrosis. Patient fourteen years of age. Case treated with cresol followed by tincture of iodin and beechwood creosote. A, film with wires in place; B, first follow-up film six months after root was filled; C, second follow-up film one year after treatment.

cent. It should be stated in this classification if a bit of filling material, no matter how small, passed thru the foramen it was counted as overfilled, or if the gutta-percha reached to within 1 mm. of the end, it was classed as an underfilling, also that this is entirely the work of students.

Overfillings

Not so long ago we were told to overfill the canals and for a while I attempted to do this. However, after we had an opportunity to review a set of carefully prepared case histories the results found compelled us to change our methods. Where a vital pulp has been removed, as has been described above, and an overfilling has occurred, it is usually found when examining the case in from six to twelve months that the radiograms show a small rarefied area immediately surrounding the cap of gutta-percha. The gutta-percha has caused pressure on the fibers and has produced what is called, for want of a better term, pressure atrophy. This area is not necessarily infected, but of course the resistance of the tissue has been reduced and it is liable to become the seat of infection at any time. In cases where the periapical tissue shows disturbance an overfilling is not so harmful as in cases with a normal periapical membrane.

Good and Underfillings

By a good filling we mean one that is just flush with the root end. This is the type of filling we always strive for but we do not always obtain. When the canal is entirely filled with a solid homogeneous mass of gutta-percha we feel the best results may be had. However, the filling that reaches to within 1 mm. of the apex, or to the dento-cemental junction is preferred to an overfilling, according to our records. It has been stated that in such cases, where a healthy pulp has been removed the ultimate sealing of the foramen will be with calcified material. This is another contention that must be determined by cooperation of clinical and laboratory investigation.

It is not suggested that the studies which I have mentioned are at an end, as I have merely presented some of the evidence collected, in the hope it would enlist the interest of a few to keep a record of their private cases, and aid in the final solution of these problems. It will take hundreds of cases followed over a period of years before the final status of root-canal work can be determined.

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Discussion

Frederick B. Noyes: For our purpose, I shall discuss this subject from a biological standpoint. The first theorem that needs to be propounded is perhaps that life is reaction, and whatever you do in the treatment of pulps, in the treatment of peridental membranes, in the treatment of any living tissue is to be measured in biological, not mechanical standards. What you are after is a cellular reaction, a tissue reaction, a biological response. In other words, in everything that involves everyone of these subjects in practice you must think in terms of cell and cell reaction, not in terms of mechanical procedure or drugs. You have a biological problem in the handling of which you must use technical and mechanical skill to control the biological condition.

The reason we have had to face such a terrible arraignment as a profession in the last few years is primarily because we have not been trained to think in terms of biological conceptions, and we have been trained to act in terms of mechanical procedures, and the solution of the pulpless tooth problem will

be solved by the profession only when the majority of all practitioners of dentistry think at the chair, in terms of tissues and tissue reactions. Some of you have heard me say that before. In talking to Freshmen in histology it has been the reason that some of us have given for the study of these subjects, and in spite of that we have been able to obtain sometimes but little response.

Obviously all living tissues are permeable; if they were not permeable they could not live, for every living thing must constantly receive and give up; every living cell must have a means of receiving and a means of giving up. We have perhaps been a little prone to think of a line of absolute demarcation between cementum and dentin, and still I want to emphasize now, in the face of the pictures we have seen, the fact that cementum is dependent for its nutrition upon the outside surface; that it is formed from within outward and its nutritive relationship is on its outer surface, and that dentin is formed from without inward, and its nutritive reaction is on its inner surface. If there were as much permeability between the cementum and the dentin as there is in the cementum or as there is in the dentin, I doubt if we would ever be able to save pulpless teeth, but there is not. That does not say there is no permeability, but just look at any picture and think for a minute of the multitude, the millions of dentinal tubules, and the multitude of communications in the cementum, and that there is an interlocking between the two, but the line of demarcation is I believe certain but relatively little, so much so that when all vitality has been removed from the dentin, I have not yet seen any indication of any reaction in the cellular elements of the cementum. That does not say that you cannot get any reaction; but I have said many times, and I say it again, that the reason that a tooth can be retained after its pulp has been removed is because the dentin is entirely inclosed in another tissue whose vitality is not dependent on the dentin.

Dr. Hatton has given you some of the most beautiful presentations that I have ever seen, and he has presented some of the most important and fundamental considerations in the treatment of pulps and pulpless teeth. I never could understand why in any case a man wants to ram thru the end of the root into the peridental membrane, and I do not see how any man with any biological conception of the conditions of these tissues could ever do it. A pulp, as such, stops not at the outside surface of the cementum, but at the inside surface of the dentin, and the tissues which occupy the space from the surface of the dentin to the outside surface of the cementum are merely a conducting connective tissue of entirely different character from the rest of the pulp tissue. It always was of different character.

Dr. Hatton showed you changes in the pulp chamber and in these canals, and in those changes which go on in that tissue—I mean the pulp—as long as the pulp retains its embryonal character, it retains odontoblasts, and calcifications; it produces the type of dentin, but as soon as that tissue either from degeneration or from changes with age or construction loses its embryonal character and takes on a fibrous character, the calcifications take on a character similar to that which occurs in calcification under other fibrous membranes, like cementum and bone. In other words, you lose the tubular dentin type and you see a type resembling cementum and resembling bone forming in the pulp, but you have had an antecedent in the character of the pulp tissue.

Dr. Hatton emphasized with the illustrations that infection was the thing which determined the reaction. If the infection was severe, you got no tissue reaction; if the infection is mild, you get an attempt at tissue reaction, but if you can have no infection, you may have tissue reactions going on which will not do damage, but which will help out your work. In other words, what you are after is to bring about these tissue reactions. Many years ago I said that in my opinion, without any evidence whatever to the effect, if we could remove a pulp at the right point and have no infection, we would have the end of that root covered by a new layer of cementum and it would be closed. I believe yet we will be able to show that on the screen in serial sections which will show every step in it, and I believe what we have seen is a step in the way of added evidence in that direction.

Dr. Blayney has given us a great deal to think about. We ought not to need to have a man come to us with the tabulated evidence to show us that we should not apply pressure anesthesia to an exposed pulp. If we had thought in terms of biology, we would not have had that answer, because we would have known that if we apply any pressure to carry a drug thru the pulp into the apical tissue we carry with it infection, and infect the apical tissue, but we had to have that hammered into us with a sledge before we realized it. I hope that no man will ever go back to his practice and finding a pulp exposed by caries will apply pressure anesthesia without treatment.

Dr. Blayney in his slides showed at least one case where the tooth, with symptoms of vitality in its pulp, showed tissue reactions beyond the apex of its root. Why not? The

infection was not sufficient to kill. If you could have taken sections of the pulp, you would have found tissue reaction in the pulp thru its entire extent and passing beyond the pulp along the line of progress. I want finally to remind you that the tissue around the apex of a root is of a peculiar character; it is made up very largely of strong dense bundles of fibers, a kind of tissue which has a low-grade reaction to infection, consequently we must be especially careful about infecting that kind of tissue, and we must be cautious in our expectations of vital reaction in the combating of infections in that kind of tissue. Lastly, we must learn to think in terms of biological reactions, which is the whole problem.

Edgar D. Coolidge: I believe there is a very important message in what we have heard tonight. The relation between these three papers has been beautifully brought out by Dr. Noyes, who has led us to see this matter in the light of biology and to make us realize that we have been working in the dark, because we have looked at it too much as a mechanical problem. Some very important points were brought out, one of which is that if live and healthy pulp tissue can be found beneath some partially filled roots we should employ such methods of pulp destruction and removal that will not injure the many collateral filaments and branches and apical portion which cannot be successfully removed and give nature the best opportunity to keep it alive and healthy.

Dr. Blayney has brought to our attention another very important point in regard to pulp removal. We have felt for some time that there have been grave mistakes made in pressure anesthesia but we did not realize that there were so great a number of cases in which these disturbances could actually be found to follow this method of pulp removal. In checking up these cases one after another in the clinic Dr. Blayney's attention was called to it, but he did not realize the percentage of these cases until he began to analyze and tabulate them. This is a direct illustration of the value of accurate records and checking up one's work. The thing for us to carry home with us is simply this, that an exposed pulp is an infected pulp, and we must not deal with it as we would with one that is intentionally or accidentally exposed in a sound tooth where caries has not approached it. In all those cases of pulp exposure, we must be exceedingly careful not to infect the periapical tissue by means of pressure anesthesia and the precaution we must take has been very clearly demonstrated to us by Dr. Blayney, that is we should always seal the cavity with a mild antiseptic treatment for twenty-four hours before attempting to remove the pulp.

Dr. Skillen (closing): It can be demonstrated that changes take place in the pulp canal from stimuli. Probably the same thing can happen on the outside as from the inside from stimuli of the pulp. Those two things have not been gone into deeply so far. We cannot say positively that such changes will not take place thru the cementum and the dentin; therefore, the question of permeability still stands as one of the fundamental principles until the problem of root canal treatment has been settled. In a certain percentage of successful cases permeability as well as every characteristic of the tissue involved must be taken into full consideration.

Dr. Hatton (closing): I would like to repeat that failures in pulp canal work are due to accidents, and the chief accident is infection. Infection is the most serious thing that may occur to the apical region of a tooth, and anything that will preserve a tooth from infection ought to be encouraged. Infection may be conveyed by the circulation, by the lymph channels, or be introduced by dental instruments.

Dr. Blayney (closing): If what I have said will induce you to keep accurate records of your pulp canal treatments, and to make clear-cut diagnoses before you attempt to do root-canal work, I shall feel amply repaid.

SOME OBSERVATIONS OF JAW RELATIONSHIP TO BE CONSIDERED DURING FULL DENTURE CONSTRUCTION

By WALTER HENRY WRIGHT, D.D.S., Pittsburgh, Pennsylvania

(Read before the National Society of Denture Prosthetists, Milwaukee, Wisconsin, August 1-13, 1921)

A year ago it was my pleasure to report several cases of malposition of the jaws accompanied by defective hearing. Upon correction of the jaw relationship the hearing was so improved as to leave little doubt concerning the connection between the two. At that time a general description of the anatomy of the parts involved was given to show the relationship of the various structures surrounding the temporomandibular point. The present paper will try to sum up some of the important points and influences which have a direct bearing upon malposition of the jaws as we find it in edentulous cases.

We strive in our restorations to simulate the most perfect natural masticatory mechanism obtainable, therefore we should consider such a unit in our quest for fundamentals. We are impressed with the complication of the masticatory apparatus as we study the various structures which make up this unit: (1) the teeth, their form and position in the dental arches; (2) the mandible and maxilla, their individual form and relationship; (3) the musculature, and musculation (muscle activity); (4) structures of the temporomandibular joint, their relationship and functions. It is unnecessary to describe the structures just mentioned. All are familiar with them. We will pass at once to the fundamentals.

When perfect natural teeth are in central occlusion the teeth of the maxilla support not only the teeth of the mandible but the mandible itself. To illustrate: a skull may be placed upside down and if the teeth are placed in central occlusion the maxillary teeth will support the mandible in perfect relationship (Fig. 1). In fact if the teeth were held rigidly in central occlusion a novice might be persuaded that the mandible is attached to the skull thru osseous union the same as the maxilla. This fact is of utmost importance since it demonstrates the perfect balance existing between the mandible and maxilla. When we stop to think that the teeth come into central occlusion after almost every lateral movement during mastication we are impressed with the importance of this arrangement. I presume that as the teeth come into central occlusion practically all the force not applied to the food during musculation is lost between the teeth; and I have proved to my own satisfaction that the structures of the temporomandibular joint receive little if any pressure while the teeth are in this position (Figs. 2 and 3).

A knowledge of the forces of mastication upon the normal masticatory appa-

ratus is essential if we are to appreciate the effect of these forces under abnormal conditions. The works of Alfred Gysi furnish sufficient evidence from which to make our deductions. By means of a mechanical device Dr. Gysi has simu-

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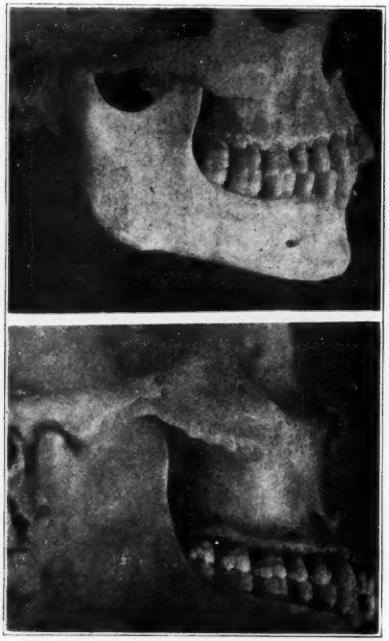

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Figs. 1 and 2.—Fig. 1, everted skull, maxillary teeth supporting mandible in perfect relationship. Fig. 2, teeth in central occlusion, showing space between the condyle and floor of the fossa.

lated the action of the mandible while crushing a cherry stone between the lower and upper second molars. During this experiment it was found that pressure amounting to sixty pounds was brought to bear upon the stone, at the same time twenty-seven pounds was registered upon the balancing condyle, while no fulcrum-making force was recorded at the working condyle. This demonstration shows us that the condyle and meniscus are integral parts of the normal masticatory unit and that the condyle on the balancing side, or the condyle with the greatest range of motion, takes the greatest stress during mastication (Fig. 4). As food is placed nearer the median line, the working condyle develops a greater range of motion and withstands greater force of mastication. During incisive action the range of motion of both condyles is nearly equal, and under

Fig. 3.—Close view of condyle, same as Fig. 2.

normal conditions the amount of pressure upon each meniscus should be the same. Incisive action occurs probably one-twentieth as frequently as lateral motion, so that it is reasonable to suppose that during mastication one condyle at a time is the seat of fulcrum-making pressure, the balancing condyle, while the working condyle receives considerably less pressure (Fig. 5.) The rapid alternation of a condyle from balancing to working and vice versa seems to indicate a period of rest for each condyle during mastication.

To sum up the points in a few words we find that pressure applied to a condyle during mastication is usually accompanied by motion, or recession of that condyle from the eminentia. The working or more stationary condyle receives

less pressure. So it would seem that nature has wisely constructed the masticatory apparatus; for anyone who has examined the temporomandibular joint

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Figs. 4 and 5.—Fig. 4, balancing condyle near the crest of the eminentia articularis. Fig. 5, working condyle, near base of eminentia.

will agree that, as long as a condyle is moving normally, an enormous amount of stress may be applied without injury to it or the surrounding tissues. The most ideal mechanical device could not be operated with less friction; and science has not yet invented a lubricating material equal to the synovial fluid.

A study of the forces of mastication impresses us with the importance of maintaining the structures of the temporomandibular point in their normal condition or state of greatest efficiency.

This fact is proved by observance of the child from two to seven years of age. Before an attempt has been made to mas-

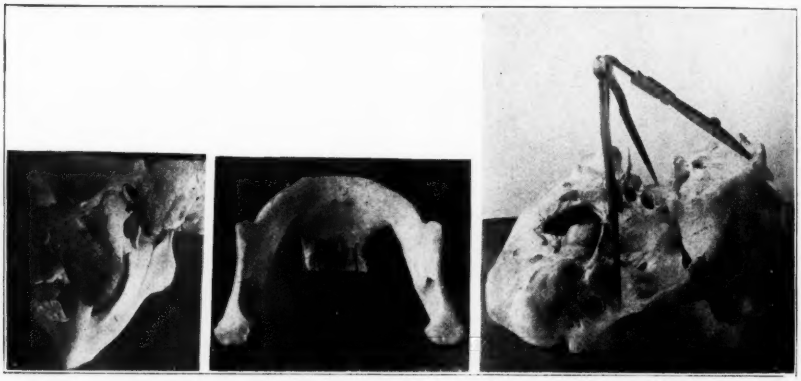
Fig. 6.—Skull of child, sixth-year molars in position.

ticate solid foods, nature places molars in position which are not only for the purpose of masticating food and causing proper development, but also to maintain that necessary balance between the jaws which keeps undue pressure from the joint. Before the deciduous teeth are lost an additional safeguard appears, the sixth-year molar which assists in maintaining this balance during the transitional period (Fig. 6.)

With these observations well fixed in our minds let us apply them to conditions as we meet them. Let us appreciate the fact that if a single tooth is missing

it constitutes an abnormality or pathologic condition and that the fewer teeth remaining the more serious the effect depending upon the position of those remaining, while the unrestored edentulous case approximates a tragedy. Unfortunately the posterior teeth are usually lost first, the uppers probably a little earlier than the lowers. The results are quite similiar in both cases except as we shall note later. When either the upper or lower posterior teeth are lost, the balance cles of the working side with probably a less amount at the working condyle. In abnormal cases, as described previously, the mandible becomes a lever of the third class, with the bolus of food between the anterior teeth, forming the weight, the masseter, internal pterygoid and temporal muscles, forming the power, and the condyles forming the fulcrum (Fig.7.)

In cases where the lower posteriors are lost we see then a typical tripod: the anterior teeth in articulation with the



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Figs. 7, 8, and 9.—Fig. 7, loss of lower posterior teeth, bolus of food at anterior teeth, condyles as fulcra and muscles between (masseter only in position). Fig. 8, mandible showing three points of suspension; anterior teeth and both condyles. Fig. 9, representing Figs. 7 and 8, the dividers indicate the regions of support during mastication.

existing in normal cases is lacking. The maxillary teeth no longer support the mandible, the working condyle has become a balancing condyle and both are continuously burdened with the stress of mastication. The condition as it exists here is best described by showing its resemblance to a tripod. In normal cases the teeth, having more than three points of contact, during central occlusion, are self-supporting. During lateral motion the pressure generated by musculation is lost between the balancing condyle and eminentia, the bolus of food, and the musupper anteriors forms the anterior legs, and the condyles resting on the eminentia or in the fossae form the two posterior legs (Fig. 8 and 9). If conditions remained as we see them after the recent loss of the lower posteriors we would have little to fear. But after the molars are lost the body immediately anterior to the angles of the mandible becomes weakened due to the great amount of atrophy. Continued pressure by the masseter, internal pterygoid muscles, at this the weakest point soon cause a widening of the angle, forming

an obtuse instead of a right angle, with the result that the length of the mandible from symphysis to condyles is increased. The additional length of the mandible confines the motion of the condyles to a more posterior position on the eminentia and possibly to the floor of the fossa during mastication. This condition is aggravated by the fact that the additional burden placed upon the remaining anterior teeth soon causes abrasion and a closed bite. It is entirely possible that in these cases the condyles are snugly seated in the fossae before the final masticatory effort is exerted. This causes great pressure upon the inter-articular-fibro-cartilage, followed by atrophy or destruction and sometimes abrasion of the cartilage covering the condyle and floor of the fossa, or even forcing the condyle posteriorly to the non-articular part of the fossa (Figs. 10 and 11). The results following the loss of the upper posteriors and the retention of the lower posteriors may be similar with the exception that the neck of the condyle being the weakest point in this case is subjected to flexion causing posterior displacement of the condyle (Figs. 12, 13, 14). Loss of certain teeth is not essential to destruction of the tissues about the joint. In cases of pronounced abrasion the bite is usually closed to such an extent that when the teeth are in central occlusion the condyles make pressure upon the meniscus (Fig. 15). This means that after each lateral movement instead of the final impact being lost between the teeth, as in normal cases, it is partially lost between the condyle and the eminentia, with the result that the meniscus may become atrophied or even perforated. Most cases of abrasion present a diminished space between the condyle and fossa indicating atrophy of the meniscus. (Figs. 16, 17, 18, 19, 20, 21, 22). Nor does the ill effect of such conditions stop here. As the bite becomes closed the muscles must of necessity adapt themselves to new conditions. They become contracted and being free from the guiding influences of normal tooth form and arrangment, develop an abnormal and poorly defined range of motion which presents a formidable obstacle to its successful correction.

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Figs. 10 and 11.—Fig. 10, normal mandible; the anterior border of coronoid process is at a right angle with the body. Fig. 11, widened angle and posterior position of the ramus due to loss of posterior teeth and abnormal pressure during mastication.

To a greater or less extent the conditions just mentioned are the rule instead of the exception. It is characteristic of human nature to retain the teeth as long as possible and only in the greatest emergency to part with those condemned. This fact results in the gradual loss of the teeth and a prolonged delay in having them replaced with an

artificial substitute. We know the majority of these cases go dentureless until their health is endangered by such carelessness. This then is the problem we are to solve when constructing full dentures and unless we have been familiar with the case before the natural teeth were lost we are greatly handicapped in determining the difficulties to be encountered during and after restoration.

This then is our task, to construct dentures in cases which have, by continued misuse, established abnormal occlusion, malposition of the jaws and pathological conditions in various components of the masticatory apparatus.

12 13 14

Figs. 12, 13, 14.—Fig. 12, normal mandible; perpendicular erected at angle passes midway between condyle and coronoid process. The posterior border of the ramus forms an angle of 120° with the body. Fig. 13, posterior teeth missing; perpendicular passes thru coronoid process, the angle present is 130°. Fig. 14, loss of upper posteriors and retention of lower posteriors; posterior position of the condyles, 130° angle present.

Restoration of normal conditions therefore in many cases is an impossibility for it presupposes attainment of the following: normal relationship of the mandible to the maxilla; proper working conditions for the muscles; normal condition and relation of the structures of the temporomandibular joint; proper facial proportion.

We found, from our study of the normal conditions, that when the teeth were in central occlusion, little pressure was exerted upon the meniscus because of the perfect balance between the upper and lower teeth. Also that in endentulous cases that balance is lost and pressure is imposed upon the meniscus. The problem before us is to correct this condition by relieving pressure upon the meniscus when dentures are in central occlusion. It is obvious that if occlusion rims are adapted to a case under biting stress that the rims, being compressible, will form one point of suspension for the mandibular tripod, the condyles forming the other two, thus simulating conditions described above (Fig. 23). This pressure is gradually relieved by atrophy of the inter-articular-fibro-cartilage, and attended with ill effects.

Another serious handicap in such restorations is found in the changed form of the angle of the mandible or of the neck of the condyle. It can readily be appreciated that if this change has taken place and dentures are constructed to reproduce normal central occlusion that the condyles will occupy an abnormal position in the glenoid fossa resulting in impaired function when the dentures are completed. Careful examination of the external auditory meatus and joint region will reveal the fact that in cases of this kind the condyles are forced posteriorly when the mandible approximates the maxilla too closely. This dislocation can ofttimes be revealed by placing the tip of the index finger into either external auditory canal and making pressure against the anterior wall.

When the mandible is elevated a peculiar backward thrust of the condyle is experienced as the muscular balance is lost. In these cases it is necessary to open

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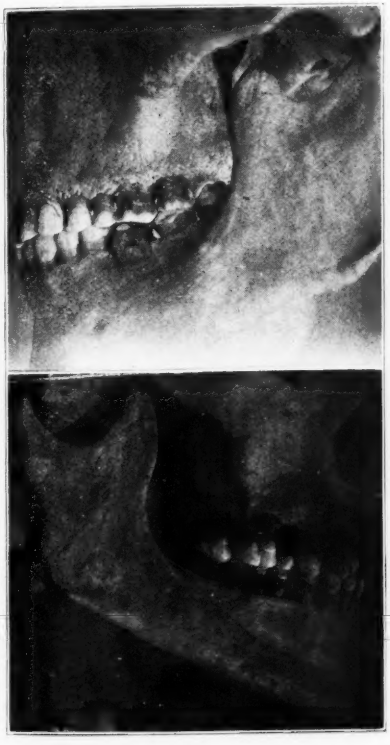

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Figs. 15 and 16.—Fig. 15, case presenting abrasion; diminished space between condyle and floor of glenoid fossa. Fig. 16, another case of abrasion.

the bite until this backward thrust is abolished, when occlusion rims are in proper relationship. This necessitates opening the bite to a greater extent when restorations are made than when the natural teeth were intact, and in some cases requires lengthening the proportion of the lower third of the face with the result that aesthetics must be sacrificed in order to obtain more nearly the correct position of the condyle.

Let us note briefly some observations after denture construction. If the ridge of an edentulous mandible is examined carefully we note that it presents a comparative uniformity in size and form,

Fig. 17.—Comparison of the spaces between the condyle and floor of the fossa in the normal skull and in a skull where abrasion is present. A wax pattern of the space is seen on the squamous portion of the temporal bone in each case.

from the median line to the region of the third molar. The maxillary ridge is usually less in circumference but greater in thickness from buccal or labial to lingual, while the mandibular ridge altho less in lateral thickness is greater in circumference and density of osseous structure. If all conditions were equal we might expect an equal atrophy of both ridges under dentures. But due to

increased surface obtained by covering the palate with the maxillary denture and the ill effect of continued pressure by the mandibular denture, atrophy of the mandibular ridge is greater than the maxillary.

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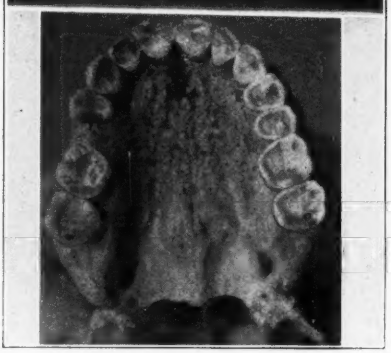

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Figs. 18 and 19.—Fig. 18, mandible showing amount of abrasion present. Same as Fig. 17. Fig. 19, maxilla showing amount of abrasion present. Same as Fig. 17.

It is obvious that if the greater part of mastication occurs between the posterior teeth, the posterior portion of each ridge will be more rapidly atrophied than the anterior part. This is due to the fact that crushing action occurs many times more frequently than incisive action and the occlusal form of artificial molars creates more pressure during mastication than the anterior teeth, while their nearness to the center of applied force exaggerates that pressure.

Unequal atrophy of the posterior portion of either ridge allows too great stress to be exerted upon the anteriors which causes atrophy in this region. This compensatory action continues thruout the wearing of dentures. Examination of restored cases will show loss of contact between maxillary and mandibular molars after a short time. The conditions present in such cases allows the

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Figs. 20 and 21.—Fig. 20, measurement proves mandible outline in Fig. 18 to be nearly normal. Fig. 21, loss of occlusal relationship with upper molars allows ramus to change its outline. An angle of 135° is present.

initial masticatory force to effect the bolus of food, while the final force brings the incisors into strong contact, forming a tripod mandible as previously described. Atrophy of ridges under dentures may be compared to abrasion of the natural teeth, since it allows the

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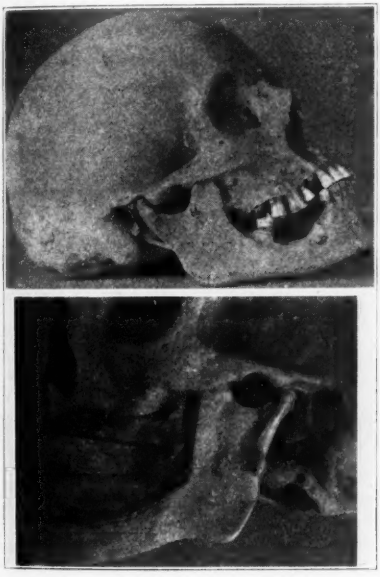

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Figs. 22 and 23.—Fig. 22, retention of the lower third molar maintained to a great extent the normal form of the mandible. Fig. 23, edentulous skull with occlusal rims restoring jaw relationship.

mandible to approach the maxilla too closely and allows the condyles to create too much pressure upon the inter-articular-fibro-cartilage.

Correction of all these conditions, it is readily seen, depends upon establishing as nearly as possible the same relationship in the temporormandibular joint as we find in the normal dentulous case. Since nearly all edentulous cases have passed thru one or more of the stages named they all present problems

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Figs. 24 and 25.—Fig. 24, edentulous mandible showing angle of ramus and condyle: the anterior teeth were lost recently. Fig. 25, another edentulous mandible.

in proportion to the amount of pathology present (Figs. 24, 25, 26, 27). A full history of the case regarding the loss of teeth helps considerably in determining

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Figs 26 and 27.—Fig. 26, mandible showing abrasion of teeth and atrophy of the right condyle. Fig 27, mandible where anteriors were lost recently showing atrophy of the right condyle.

the proper procedure when restoration is attempted.

Careful observations of the mandibular outline, region of the condyle during musculation, muscle development and activity, and atrophy of the mandibular and maxillary ridges are important since they supply evidence of disuse or abuse while the teeth were present.

In conclusion let us record the essential points to be observed during restoration of these cases.

1. The balance between the maxilla and mandible as seen in normal occlusion is so perfect as to take care of the final masticatory effort between the teeth in central occlusion, thus relieving the inter-articular-fibro-cartilages of undue pressure.

2. The temporomandibular joint is constructed so that a moving condyle and meniscus is best able to withstand fulcrum-making pressure.

3. A closed bite resulting from extensive abrasion of the teeth may allow the condyles to exert great pressure upon the meniscus since they approach the floor of the fossa closer and compress the cartilage as the teeth come into central occlusion.

4. The loss of the posterior teeth, which is a very common occurrence, allows the mandible to function with three points of suspension, forming a third-class lever, which results in widening the angles or bending back the condyles causing, in many cases, extensive atrophy of the cartilage and even abrasion of the osseous structures.

5. The musculature develops habits difficult to overcome due to the abnormal relationship of the jaws.

6. An edentulous case usually presents one or more of the abnormal conditions mentioned and offers difficulties which in the most ideal case renders the artificial substitute greatly inferior to nature's handiwork.

And finally since an ounce of prevention is worth a pound of cure, and we are the ones who are expected to cure, altho in many cases a satisfactory result is impossible, let us spread abroad the truth that a complete denture is absolutely necessary whether it be natural or artificial. Let us purify the stream by not only cleansing its source but also by guarding its course, that the nightmare-incurables will have vanished before the glad ray of *prevention.*

STUDIES IN ROOT-CANAL STERILIZATION. III[1]

By JOHN A. MARSHALL, D.D.S., Ph.D., San Francisco, California

(Read before the National Dental Association, Milwaukee, Wisconsin, August 15-19, 1921)

Introduction

THE study of the problem of sterilization of pulp canals falls into three main divisions. The first is concerned with the gross and microscopic anatomy of the dentin and cementum; the second, with methods of treatment, and the third, with an analysis of the results from a clinical and bacteriological standpoint. A contribution to the microscopic anatomy was offered in a report upon the organic matrices of dentin and cementum and in it a method was described by which it is possible to separate and differentiate the organic matrices of the structures concerned (1). This separation between the two structures, as has been previously observed, indicates that dentin matrix and cementum matrix are without demonstrable connection. Since it has been proved by others that the ground section of a calcified specimen presents no conclusive evidence of direct communication it follows that with the exception of accessory foramina, there have been no experimental data submitted which would suggest the existence of this anatomical characteristic. These researches point, on the other hand, to the fact that the structures do not possess interlocking fibers in the organic matrices, or communicating channels in the calcified specimen. It follows, then, that antiseptics or fluids which are placed in the pulp canal for the purpose of sterilization are probably not directly subject to dilution and removal by the collateral circulation of the peridental membrane. Osmosis may tend toward such a dilution and the possibility of this action has been discussed in a previous article.

The extent of penetration of fluids in general and of certain antiseptic solutions in particular was demonstrated in a second article (2). Included in this discussion was the description of a new application of a solution of crystal violet and brilliant green. The advantages and disadvantages which this solution possesses were compared with other antiseptics and in particular with the silver treatment as advocated by Dr. Howe.

The next part of the problem deals with the relative efficiency of the antiseptics employed and may be summarized by the question, What success may clinicians expect from the treatment of infected teeth and how may that success best be measured?

This paper reports the results obtained from bacteriological tests following the treatment of infected pulp canals. It constitutes, in fact, a preliminary survey of two problems. First, a consideration of different sterilization methods adopted in this class of dental operation, and second, a comparison of clinical and laboratory results obtained with a few selected antiseptics. The work reported is based on clinical and laboratory records of 127 cases presented at the dental clinic of the College of Dentistry, University of California.

At the beginning of the experiment it was sought to determine whether it

[1]From the Research Laboratories of the George Williams Hooper Foundation for Medical Research and of the College of Dentistry, University of California. Aided by grant from the National Dental Association

was possible to treat a pulp canal in the clinic in such a manner as to render it sterile. Altho our present technic has been improved by the correlation and interpretation of laboratory data, the clinical findings have not been sufficiently tabulated and analyzed. It is this tabulation and analysis which is presented for your consideration. The research of Cevey reported from Zurich is confirmed, but the list of antiseptics employed by him has been considerably extended.

In seeking for a standard clinical method of procedure, it is at once apparent that the factors in the personal equation, or the habits and technic of the operator, are variable and fluctuating. Clinical procedure is never absolute. It is relative, not only from the standpoint of the operator, but also when compared with the work of others. It is not claimed that the operative details which were assigned have any particular virtue over others. They were adopted as a standard because it was necessary, when beginning experimental work, to formulate uniform procedures which will render reliable results, and which admit of clinical adoption.

After the assignment of the patient to the student a differential diagnosis of the pathological condition was made by the operator and then corrected or confirmed by the instructor. Following this the designated treatment for the case was instituted and continued under careful supervision. At the conclusion of the treatment the pulp canal was tested for sterility, as described later. The sterilized rubber dam was adjusted and the exposed area, both dam and teeth, washed several times with 70 per cent alcohol. The tooth under obs rvation was then carefully opened, the dressing removed and the canals dried with sterilized cotton points.

It has been reported by Pond (3) and others that the cotton points supplied to the profession in "aseptic" (?) sealed cartons are usually contaminated. Altho the contamination may be from an organism of a non-pathogenic type, it is nevertheless incorrect to assume that such a dressing is aseptic. All dressings used were sterilized in test-tubes placed in the Rochester type of steam sterilizer.

In the treatment of an individual case, a score or more of these points were shaken from a test-tube into a sterile petri dish, a procedure which obviated the necessity of inserting an instrument into the tube. For if an instrument is used to carry the points from a test-tube to the canal directly, there is always the probability of contamination of the entire stock. By placing sufficient points for the case at hand in the petri dish, this risk is reduced to a minimum. The dressing is carried from this container to the tooth with treatment pliers. These are first dipped in alcohol and then flamed before picking up the cotton point. The cover of the petri dish should not be removed entirely, but should be raised just enough to permit access to the sterilized canal dressing in the dish. In preparing the pulp canal for the bacteriological test, it was first carefully dried, a fresh *dry* sterile point inserted in the cavity, and the tooth sealed in the following manner.

A small pellet of sterilized cotton was forced with pressure into the opening of the canal. Following this the apical portion of the pulp chamber was sealed with baseplate gutta-percha. The cavity was moistened with a little chloropercha, and warm baseplate gutta-percha sealed into the apical half of the pulp chamber. The remainder of the cavity is filled with Ames' crown and bridge cement. It has been found that by following this procedure more uniform results are obtained, for even the lower central incisors, teeth with small pulp chambers, may be handled in this manner. The following day the tooth was again opened under the sterile conditions described above, and the cotton removed from the canal. A series of

culture tubes, containing glucose blood broth were placed at the operator's left and the cotton point carried immediately from the pulp canal to the tube. The canal was again inspected for moisture and the second point inserted for a few moments. Usually two tests of each canal were conducted but in some cases this was not feasible.

The tube containing the point was incubated and the specimen examined microscopically, in accordance with the usual bacteriological technic. In cases where organisms were found, the material was transplanted to blood agar plates and the cultural characteristics determined.

The tables indicate the results of this experiment. They summarize the pathological condition, and the method of treating the individual cases. Frequently it was necessary to repeat the treatment and this repetition has been indicated by a numerical reference. In some instances it will be noted that the infected canal, even tho the treatment was repeated, could not be rendered sterile. The canal, however, was perfectly dry and showed no clinical sign of infection. These canals were filled in spite of the fact that it was impossible with our technic, at least, to secure a sterile test. On two occasions this practice was followed by the development of an acute apical abscess.

The administration of a large clinic is different from that of a private practice, for the reason that the patients cannot obtain the same professional attention accorded under less public conditions. Appointments are frequently cancelled and valuable time lost. It has been necessary, therefore, on some occasions to use more than one antiseptic in a canal. For example, in Case 22, Table I, a putrescent pulp was treated successively with formo-cresol, dichloramine-T, and crystal violet and brilliant green. The reasons necessitating this procedure were those over which the

TABLE I

Pulp Canals Sterile After First Series of Treatment

No. Clinical Record	*Therapy*	*Result*
93 Putrescent pulp	Beechwood creosote	Canals filled
94 Pulp exposed and extirpated by pressure anesthesia	Phenol	" "
96 Dry gangrene	Dichloramine-T	" "
105 Pulp exposure	"	" "
30 " "	"	" "
83 Putrescent pulp	Formo-cresol	" "
88 Partly putrescent pulp	Dichloramine-T	Extracted
89 " " "	"	"
90 " " "	"	"
95 Pulp exposed	Beechwood creosote	Canals filled
28 Putrescent pulp	Dichloramine-T	" "
47 Acute apical abscess	"	" "
11 No record	"	" "
12 " "	"	" "
15 Acute apical abscess	"	" "
18 Chronic apical abscess	"	" "
19 " " "	"	" "
20 " " "	"	" "
67 " " "	"	" "
68 " " "	"	" "
45 " " "	"	" "
56 " " "	"	" "
57 " " "	"	" "
58 " " "	"	" "
82 Acute apical abscess	Dichloramine-T	Canals filled
84 Chronic apical abscess	" Beechwood creosote	" "

No.	*Clinical Record*	*Therapy*	*Result*
85	Chronic apical Abscess	Beechwood creosote Dichloramine-T	Canals filled " "
101	" " "	Beechwood creosote Dichloramine-T Formo-creosol	Formo-cresol dressing in canal. No filling
102	" " "	Beechwood creosote Dichloramine-T Formo-creosol	Canal filled
106	" " "	Crystal violet and brilliant green	" "
107	" " "	Crystal violet and brilliant green	" "
108	" " "	Crystal violet and brilliant green	" "
120	" " "	Beechwood creosote	" "
125	Unfilled canal Mumifying paste	Dichloramine-T	" "
126	Unfilled canal	"	" "
121	Putrescent pulp	"	" "
123	" "	Beechwood creosote Dichloramine-T	" "
124	Pulpitis	Dichloramine-T	" "
128	Exposed pulp	"	" "
129	Putrescent pulp	"	" "
64	" "	Beechwood creosote	" "
62	Extirpated pulp	" "	
		Dichloramine-T	" "
46	Devitalized pulp As_2O_3 fiber	Beechwood creosote Dichloramine-T	" "
41	Extirpated pulp	Beechwood creosote	" "
137	Pulp exposure	Eugenol Dichloramine-T	" "
42	Putrescent pulp	Beechwood creosote	" "
138	Chronic apical abscess	Dichloramine-T	" "
139	Dry gangrene of pulp	Beechwood creosote Dichloramine-T	Canals filled
55	Exposed pulp devitalized by As_2O_3 fiber	"	" "
32	Putrescent pulp	"	" "

college had no control. In studying these tables it must be borne in mind that the efficiency of dichloramine-T continues only while chlorine is being liberated from the compound. This antiseptic was applied four separate times twenty-four hours apart (4). If the dichloramine-T remained longer than twenty-four hours, the procedure was repeated. There were other instances in which the treatment was recommenced on account of faulty technic of the student. His operative skill is never as highly developed as that of an experienced operator; his method of handling instruments and of handling clinic materials is sometimes clumsy. But on the other hand, it is probable that his training in bacteriological technic is better than that of the average dentist. It is apparent, therefore, that there was a greater necessity for the re-treatment of canals than would be necessary in private practice with an experienced operator.

In Table I are grouped those cases which after the first series of treatments were found sterile by laboratory test. The clinical record includes acute and chronic apical abcess as well as putrescent and gangerenous pulp conditions.

Experiments 88, 89, and 90 deserve comment. In this particular case, a partly putrescent pulp was causing severe pain and a mandibular injection for removal of the residual hypersensitive pulp filaments was unsuccessful. After a series of treatments with dichloramine-

T followed by eugenol, the inflammation subsided to such an extent that devitalizing fiber was applied. Subsequently the remaining pulp stumps were removed and the canals prepared for filling. A radiograph taken at this time showed that one of the canals had not been opened entirely to the apex. Further attempts at reaming the canal were unsuccessful. A second radiograph taken with the diagnostic wires in place was misinterpreted and a diagnosis of a perforated root was made. On extraction of the tooth the roots were carefully examined but no perforation could be found.

Table II summarizes the pathology, treatment, and the result of cases similar to those in Table I.

Since none of these proved sterile after the first test, the therapy was repeated. A numerical reference in the third column has been given which furnishes an index to the subsequent data found in Tables II and IV.

Altho the majority of cases cleared up satisfactorily after this renewed attempt at sterilization, there were some of these which apparently remained infected. These are summarized in Table IV.

With the permission of the patient the canals were filled and the patient in-

TABLE II

Pulp Canals Infected After First Series of Treatments

No.	*Clinical Record*	*Therapy*	*Result*	
70	Acute apical abscess	Dichloramine-T	Treatment repeated	98
71	" " "	"	"	" 99
72	" " "	"	"	" 100
34	Dry gangrene	Beechwood creosote	"	" 34a
73	Chronic apical abscess	Crystal violet and brilliant green	"	" 73a
74	Putrescent pulp	Crystal violet and brilliant green	"	" 74a
40	Infected pulp	Eugenol	"	" 40a
54	" "	Beechwood creosote Crystal violet and brilliant green	"	" 54a
43	" "	Dichloramine-T	"	" 44
22	Putrescent pulp	Formo-creosol Dichloramine-T Crystal violet and brilliant green	"	" 29 & 29x
21	Chronic apical abscess	Dichloramine-T Beechwood creosote	"	" 23
13	Putrescent pulp acute pericementitis	Dichloramine-T Beechwood creosote 11/17/20.-1/20/21 Dichloramine-T 1/20/21 - 1/24/21	"	" 13a
14	Putrescent pulp acute pericementitis	Dichloramine-T Beechwood creosote Dichloramine-T	"	" 14a
80	Putrescent pulp	"	"	" 80a
97	Pulp exposure	"	"	" 97a
86	Putrescent pulp	" Beechwood creosote Formo-cresol	"	" 86a
103	Pulp exposed	Dichloramine-T	"	" 103a
104	" "	"	"	" 104a
38	Acute apical abscess	Dichloramine-T	Patient did not return for further treatment	

No.	Clinical Record	Therapy	Result
127	Unfilled canal	Dichloramine-T	Treatment repeated 127a
1	No record	Beechwood creosote	" " 1a
2	" "	" "	" " 2a
3	" "	" "	" " 3a
17	" "	Dichloramine-T	" " 17a
66	" "	"	" " 69
49	" "	Beechwood creosote	" " 65
65	" "	" "	" " 81
76	" "	" "	" " 87
75	" "	Dichloramine-T	" " 91
111	" "	"	" "
112	" "	"	" "
113	" "	"	" "
114	" "	Beechwood creosote	" "
115	" "	" "	" "

TABLE III

Pulp Canals Sterile After Second Series of Treatments

No.	Clinical Record	Therapy	Result
80a	Repetition of 80	Crystal violet and brilliant green	Canals filled
97a	" " 97	Dichloramine-T Crystal violet and brilliant green	" "
86a	" " 86	Dichloramine-T	" "
103a	" "103	" Crystal violet and brilliant green	" "
104a	" "104	Dichloramine-T Crystal violet and brilliant green	" "
127a	" "127	Dichloramine-T	" "
98	" " 70	"	" "
99	" " 71	"	" "
100	" " 72	"	" "
34a	" " 34	"	" "
73a	" " 73	Crystal violet and brilliant green	" "
74a	" " 74	Crystal violet and brilliant green	" "
40a	" " 40	Dichloramine-T	" "
44	" " 43	"	" "
29	" " 22	"	" "
29x	Check test of 29	"	" "
23	Repetition of 21	" Crystal violet and brilliant green	" "
13a	" " 13	Dichloramine-T	" "
14a	" " 14	"	" "
17a	" " 17	"	" "
69	" " 66	"	" "
81	Repetition of 49	Dichloramine-T	Canals filled
81a	" " 65	"	" "
87	" " 76	Beechwood creosote	" "
91	" " 75	Dichloramine-T	" "
114a	" "114	"	" "
115a	" "115	"	" "
1a	" " 1	"	" "
2a	" " 2	"	" "
3a	" " 3	"	" "

TABLE IV

Pulp Canals From Which No Sterile Test Could Be Obtained

No.	*Clinical Record*	*Therapy*	*Result*
51	Imperfect canal filling	Dichloramine-T	Canals filled
52	" " "	"	" "
53	" " "	"	" "
59	" " "	"	" "
48	Putrescent pulp	"	" "
54a	Repetition of 54	Beechwood creosote Crystal violet and brilliant green	Treatment repeated 61
61	" " 54a	Dichloramine-T	Canals filled Acute apical abcess developed
33	Putrescent pulp	" Beechwood creosote	Canals filled
35	Chronic apical abscess	Dichloramine-T	Tooth extracted
36	" " "	"	" "
37	" " "	Formo-cresol	" "

TABLE V

Infected Pulp Canals

Incomplete Clinical and Laboratory Records

No.	*Clinical Record*	*Therapy*	*Result*
38	Acute apical abscess	Dichloramine-T	Patient did not return for root-canal filling
39	Canals previously filled with iodoform paste No clinical symptoms	"	" "

structed to return for observation and for further radiographic diagnosis. In those instances where it was found inadvisable to fill the canal, the tooth was extracted.

It is realized, of course, that this is only a step taken toward the study of root-canal sterilization. One of the points yet to be considered is this. After a sterilized root canal has been filled properly what condition may we expect to find at the end of six months or a year when we remove the root-canal filling? Will the area remain sterile during this interval of time or will organisms from other localities have found favorable opportunity in this region for growth? Is tissue resistance lowered in the periapical region and if so, what is the effect of this lack of tone? Theoretically the canals should be sterile and the experimental work was designated to prove or disprove this point. Clinically, however, we are still in the dark. We do not know the final result. Our lack of authentic data on this phase of the problem emphasizes the necessity of maintaining case records which show both treatments and clinical conditions at regular intervals. Whenever it becomes necessary to institute therapeutic measures, appropriate notations should be carefully recorded and checked from time to time.

In all there have been 127 cases reported. Of this number 10 per cent (Tables IV and V) remained infected after repeated treatments; 39.4 per cent were sterilized successfully the first time; 26.8 per cent were infected after the first series of treatments, and 23.6 per cent were found sterile after the repetition of the clinical procedure.

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THE USE OF MODELS IN THE DETECTION OF ABNORMAL SURFACE WEAR ON THE TEETH

By FREDERICK A. BRICKER, D.D.S., Rochester, Minnesota

(Read before the National Dental Association, Milwaukee, Wisconsin, August 15-19, 1921)

IT is a well-known clinical fact that in an infection, such as is popularly termed a cold, the condition of the body favors the development of pyogenic organisms. In periodontal areas, as in areas elsewhere in the body, the organisms may produce inflammation, terminating in suppuration. If a careful history of a case is obtained, it may be found that sensation has been increased and that the tooth or teeth are tender on percussion. If at the stage of inflammation a correct diagnosis of the cause of the condition is made and the cause is corrected, the prognosis is good. The condition may not have been noticed by the patient, however, since it is brought about so gradually that he presumes that it is normal, but the dull note which is diagnostic of thickened pericementum may be elicited, and the tooth or teeth found to be less firm than normal. The gums over the roots of these teeth usually show some pathologic changes.

One of the most important means of obtaining information concerning a main predisposing cause of periodontal disturbances of patients more than thirty-five years of age is a study of the surface wear on the teeth. The greatest percentage of periodontal disturbances at this age are caused, I believe, by improper lines of force produced upon the teeth during mastication or rest; in other words, the force directed along the lines of least resistance causes trauma; interference with the capillary circulation causes lowered resistance in the traumatized area, and infection takes place by way of the circulation. During the period of lowered resistance the osteoclasts are stimulated and cause destruction of the bone.

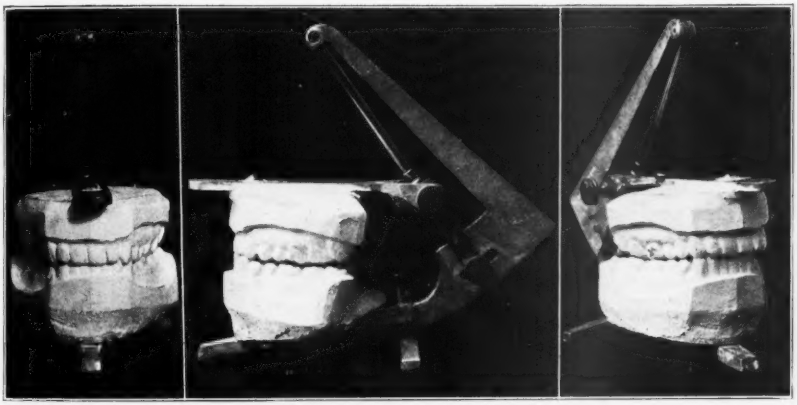
Clinical experience shows that absorption of the alveolar processes invariably takes place in areas of continued inflammation or irritation. In nearly all mouths in which the arch has not been broken by loss of teeth and which show surface wear on the buccal occlusal cusps and on the lingual surfaces of all the upper teeth, I have found surface wear on the buccal and labial surfaces, and on the lingual occlusal cusps of the lower teeth. Invariably there is loose contact, caused by forcing the teeth buccally and labially on the upper teeth and lingually on the lower teeth, which are on the lines of least resistance.

Inflammation of the bone, osteitis, may be produced by the trauma from abnormal stress in malocclusion. Inflammation of the bone may lead to rarefaction (rarefying osteitis), to condensation (condensing osteitis), or to its death (necrosis or caries). When a periodontist observes abnormal surface wear, which causes an abnormal line or direction of force, he should be able to picture the changes that are taking

place. The condition should be corrected by grinding or by restorations to insure the proper occlusion and line of force. The correction of *abnormal* surface wear wear demands knowledge of the *normal* direction of the lines of force. Stress on the teeth, while at rest and during mastication, should be placed as nearly as possible in line with the axis of the teeth. Occlusal surfaces or restorations, such as crowns and bridges, should be so

of swallowing, suction or negative pressure, as high as eight pounds, is created and drains the structures tributary to the mouth (3).

A tooth so far off the plane of occlusion as to interfere with the range of occlusion should be ground to produce disocclusion in order to allow the other teeth to function properly. Adequate occlusion is not necessarily normal occlusion, but the insidious development of



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Figs. 1, 2 and 3.—Teeth in central occlusion, forward range, and lateral range (Monson instrument).

constructed that the lines of force between the interlocking cusps may be maintained. The greater the proportion of the vertical stress to the anterior, the posterior, and the lateral stress, the greater is the probability that the teeth and their peridental membranes can withstand the stress placed on them in occlusion and mastication, and the longer will be their term of usefulness. During the act of swallowing, the teeth are in central occlusion, generally known as full occlusion, and positive pressure of from ten to fifteen pounds is exerted on the occluding surfaces. Following the act

malocclusion leads the patient to presume *that it is* normal, and even after he is informed of its abnormality he may permit the condition to remain because of the extensive operating necessary to restore the teeth.

To be able to detect the cause of an abnormal condition is half the treatment. Dr. Hurd defines diagnosis as "the art of discriminating between disease or deformities and distinguishing them by their characteristic signs and symptoms. In distinguishing between normal and abnormal surface wear on the teeth I have found it advis-

able to make plaster models. Models are as important a factor in the correction of malocclusion as they are in the practice of orthodontia. No orthodontist, no matter how wide his experience, or great his ability, would decide on a plan of treatment without first making a model for study.

The steps in the method which I use

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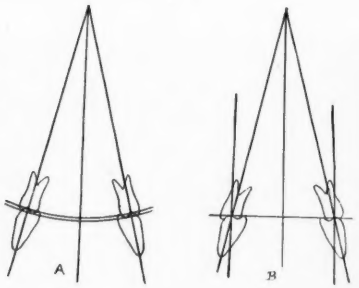

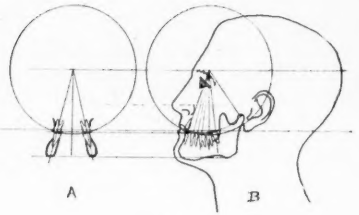

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Figs. 4 and 5.—Fig. 4, A, normal direction of force; B, abnormal direction of force. Fig. 5, A, normal direction of force; B, anterior posterior section showing the conformity of the lines to a radial point.

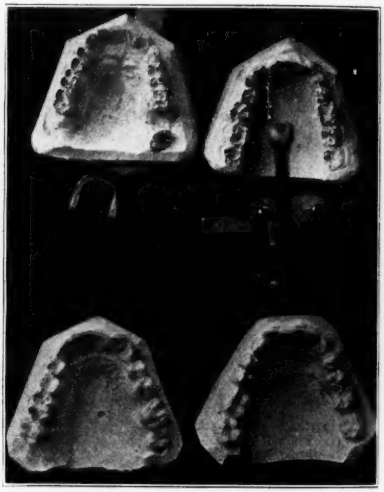
in obtaining a correct model of movable or elongated teeth at rest are as follows:

1. A cap is made by bending a strip of No. 28 gauge nickle one-fourth of an inch wide to the shape of the letter U.

2. The buccal and lingual plate is concaved with pliers to fit any tooth selected.

3. The cap is placed on any normal tooth for from three to four hours. The object is to open the bite, giving the affected teeth an opportunity to adjust themselves to a position as nearly normal as possible.

4. An impression is made in soft plaster, the impression is poured up with Healey's artificial stone, and thereby models obtained of the affected teeth in their position of rest.



Figs. 6 and 7.—Fig. 6 (above), abnormal stress on the bucco-occlusal cusps and the lingual surfaces of the upper teeth and on the linguo-occlusal cusps of the lower teeth. Fig. 7 (below), result of malocclusion of an upper first molar tooth.

5. A wax bite is taken in plate wax about one-eighth of an inch thick; the patient is not allowed to bite thru. The part of the wax impression made by the affected teeth is cut away, so that the models may rest properly in the wax bite. The model, after mounting, shows the position of the teeth at rest and the extent of malocclusion.

Unmounted models show the position

of the teeth at rest, but they do not convey any information concerning the occlusal range. By means of models carefully made and correctly mounted on instruments malocclusion may be detected and studied by observation and by use of carbon paper more accurately than is possible by the use of carbon paper in the mouth, since the patient has formed habits of occlusion to protect the sensitive teeth. The models can be observed accurately from very difficult lin-

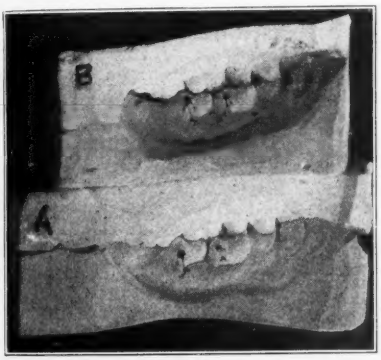


Fig 8.—Models of a set of teeth: A, before correction of malocclusion; B, after correction.

gual positions; this fact seems to me to be their most important use. They are also valuable in determining the amount of grinding or restoration required, and they make possible the study of the two arches as a unit and observation of the changes which invariably take place in the arch following the loss of a tooth or teeth. A single tooth is not of great value in itself, but its importance increases *relatively* when its position is considered as a support of the entire arch. The opportunity to educate the patient, by the use of models of his mouth, concerning the far-reaching results of the loss of one or more teeth should not be neglected. In determining the various occlusal ranges, I have found the Monson instrument (2) to be best suited to *my* needs.

In conclusion, I wish to repeat that detecting abnormal surface wear in its incipiency is, I believe, one of the most important phases of preventive dentistry; for early correction prevents the malocclusion which would necessarily follow.

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Discussion

O. L. Whitson, Los Angeles, California: I am rather radical in my treatment and where the occlusion needs it I do not hesitate to go almost thru the enamel in some cases. That is the first thing to be looked at. After you have finished your instrumentation and the polishing process you will find that you may have this all to do over again in a slight degree. Some of your teeth will be out of occlusion again and in all of those cases I have a little system of using Dr. Ward's Svelto Nos. 2, 3 or sometimes 4. Let the patients mill it, as you would mill a set of plates in the laboratory. I do not know whether that will meet with your approval or not, but I do know that I get results. I am not following any group or camp, but am doing my work "Whitson way" and if I get results I am satisfied.

I think the models are fine and those who use them are getting good results in many instances.

R. G. Richter, Milwaukee, Wisconsin: I have been very systematic in trying to correct malocclusion, but I have had much trouble in having the patients bite correctly. It is not easy to strike the right points and it is difficult to have patients to do the right thing in helping you find them.

Dr. Bricker suggested a very good idea about having the patients swallow. That is so simple a process and yet we have not seen it. When they swallow their teeth will come together in the usual occlusion and the teeth to be corrected can then be marked. I have

always taken models but they were crude compared to what we have today. Instead of the ordinary plaster we have the artificial stone which will not wear off the points as easily.

I. Hirschfeld, New York City: Dr. Bricker's paper was of great interest to me. I think that his method of reducing traumatic occlusion is an excellent one but that in itself it is not complete. I often use models as an aid, especially for the purpose of observing the articulation from the lingual aspect which cannot be done in the mouth. But I think the lecturer will agree with me that while for centric occlusion the articulated models may be utilized to very great advantage, this cannot be said of its use in the detection and correction of traumatic action in eccentric migrations of the mandible. I believe that the best articulator used today cannot be relied upon for this latter purpose.

D. F. Mosher, Kansas City, Missouri: I think the big problem is to determine in which cases to correct the occlusal trauma by grinding and in which ones the bite should be raised. After using stones I have found it is a very good plan to use Svelto No. 1 to correct the fine points of the occlusion, as well as to smooth teeth at the same time.

H. J. Leonard, Minneapolis, Minnesota: I do not believe that milling teeth with abrasive powder is a scientific procedure. In chewing tobacco we get such an effect from the grit in the tobacco and the effect is to wear down the lingual cusps of the upper molars and the buccal cusps of the lower molars and we have a reversed occlusion with traumatic occlusion on the unworn cusps. It we were to mill the teeth with some powder, we would get the same condition. It is necessary to use an articulator and study the kind of building up and grinding that will restore as nearly as possible the regular curves of the mouth. If this is not done the traumatic occlusion will continue. It is not sufficient to grind until the teeth are in nonocclusion. If the occlusion is merely ground away the teeth will extrude again until they get in contact, and if one point stands out they will get traumatic occlusion again. However, after the surgical treatment has been completed and the pericemental and gingival tissues have had an opportunity to return to normal by rest, then they will stand a greater amount of the traumatic occlusion than was sufficient to cause loosening before.

Hugh G. Tanzey, Kansas City, Missouri: Just a word in connection with the grinding of the occlusal surfaces of the teeth. It is a good idea to consider the conditions that originally existed. In correcting them it would seem advisable to consider the possibility of rearranging the teeth before you do any great amount or grinding. This might not be advisable, but we have found that it is a good plan at almost any age if the proper conditions of health are present. I think it is certainly permissible to grind the occlusal surfaces of the teeth at times, but it is a question whether any permanent results are obtained from indiscriminate grinding of the teeth.

I wish to compliment Dr. Bricker on his methods of treatment and am in favor of them, especially in connection with the securing and studying of models before treatment. I think there should be legislation requiring all dentists to secure models, not only before but after treatment and also during treatment. There is not enough studying along that line and I do not care how good a diagnostician you may be, you cannot obtain the best results without studying the models. Every dentist should keep models of every case, before, during, and after treatment.

E. A. Ihle, Chippewa Falls, Wisconsin: When there are any molar teeth missing and restoration has not been resorted to, during the past four or five years I transpose heterogeneously this lost function to the bicuspid, cuspid, and incisor regions by truing or grinding the high unworn cusps so as to establish range occlusion in these relations of the arches. I have had this in my own mouth and am aware of the splendid results derived. In the next year or two I am going to advocate modification of the occlusion under nerve blocking and in the hospital, where it is more feasible to thus treat certain cases, and as to extreme sensitiveness of the denuded dentin, I touch these areas with a burnishing instrument moistened with a solution of zinc chloride followed by a hot instrument.

Dr. Bricker (closing): The first step is to study the surface wear. I use a mouth lamp and directing the light on the lingual and occlusal surfaces of the upper teeth and the labial and buccal and occlusal of the lower teeth, detect any abnormal surface wear on the buccal occlusal cusps and the lingual surfaces of the upper teeth; the buccal surface and the lingual occlusal cusp of the lower teeth.

When I find abnormal surface wear on the

buccal occlusal cusp and on the lingual surface of the upper teeth I know the line of force is being directed on the lines of least resistance, as the labial and buccal alveolar plate has less resistance than the lingual plate, which will cause a disturbance in that area. We notice surface wear beginning at about thirty years of age but I correct abnormal surface wear at any age or whenever detected.

I simply use the instrument as a guide in grinding the teeth. After grinding the teeth with a stone I finish the case by instructing the patient, while in the chair, to chew gum incorporated with flour of pumice to get the final adjustment just as they triturate artificial teeth on an instrument.

One of the discussers spoke of cases where we find a tooth elongated. I study the occlusion before I take the impression. If a tooth is elongated and has no surface wear the chances are it is out of line of occlusion and is elongated from some other cause. I am using the models as a method of detecting abnormal surface wear. If you just have the models unmounted you may use carbon paper and determine the extent of malocclusion in central occlusion but you cannot determine the extent of malocclusion in the lateral and protrustive range of occlusion.

As regards building up the bite, we are all aware that they are the most difficult cases we have to correct: (1), if the teeth are badly worn to such an extent as to become too sensitive to grind; (2), if the upper or lower anterior teeth encroach upon the gum tissue of the opposite; (3), if the teeth are worn to such an extent as to allow the jaws to come too close together and to interfere with the negative pressure caused in the act of swallowing. Such cases require opening of bite.

In using the instrument you can get the carbon markings on the plaster teeth where it is often impossible to obtain this result on the teeth in the mouth because the patient will not bite on the sensitive teeth and also the carbon paper will often give markings where there is very slight or often no occlusion at all. If the patient will occlude on the elongated tooth it will be forced into the socket and allow the firm teeth on either side to have a more distinct marking than the offending one. The patient forms the habit of protecting those teeth and in one case we have models showing the extent of malocclusion and were able to detect the exact point of trouble by observation.

In the rearrangement of teeth at almost any age I think that would be the ideal treatment. But we have many patients present themselves for treatment and we inform them of their condition but they refuse to have the necessary correction made, because the trouble is not severe enough.

After grinding I repolish these surfaces. Thoro polishing after grinding closes up the dentinal tubules to some degree and does not leave these surfaces quite so sensitive. We make and mount study models and use them to detect and correct anterior occlusion as well as posterior. The posterior teeth always wear down first, so that if we build up the bite in time the occlusion will be too heavy on the anterior teeth and will have to be relieved because we are not using our anterior teeth to chew with as we do our posterior.

DENTAL EDUCATION, DENTAL LAWS AND THE PUBLIC

By MARTIN DEWEY, D.D.S., M.D., New York City

(Read before the St. Louis Dental Society, St. Louis, Missouri, January 16, 1922)

THE future of the dental profession depends upon three things, dental education, dental laws and the public. All three have a great bearing upon the development and usefulness of the dental profession and each one is closely related to the other. At the present time dental education is receiving much consideration owing to the activity of the Dental Educational Council of America, the Carnegie Foundation, and some proposed changes in preliminary educational requirements for dental students.

In studying any subject, it is well to take note of the beginning and see where it started from, where it is, and try to decide where it is going. Scientific men have always been interested in those problems from an evolutionary standpoint. You can always start an argument if you begin to talk about where the human family came from, and where we are going, without saying anything in regard to where we are at the present time.

Dental education had a very small beginning. The majority of men who took up the study of dentistry in the early days did so by studying under a preceptor until they had required sufficient knowledge to enable them to practice by themselves. This plan was followed for a number of years until some of the more skilful men practicing the profession decided dentistry should be taught in a college the same as medicine.

Probably one of the first attempts toward the organization of a dental college was that of Drs. Harris and Chapin when they organized the Baltimore Dental College, because they could not succeed in getting the Baltimore Medical College to establish dental education as part of the medical course. Whether that was a wise move or not is still a disputed point, but nevertheless it is a fact that the position which dentistry occupies today has been the result of activities by dentists along educational lines. In other words, the medical profession has done nothing toward the advancement of dentistry and it was only when dentistry had attained an enviable position that the medical profession became interested in the specialty.

At the present time, we find a number of medical men who seem to think that they are suited to control dental education, and desire to offer certain suggestions in regard to the future of dental schools. After the foundation of the first dental college, we find that other institutions were organized in different parts of the United States, and as the dental profession increased in power, dental

laws were enacted to control the practice of the profession in different states. We do not know which state enacted the first dental law, but we do know that the laws have been changed considerably in different states since our advent in the dental profession. These laws have been changed to a certain extent to advance dental educational standards, and these advancements along dental lines have been made possible because laws have been enacted to make certain dental eduactional requirements compulsory to those who desire to enter the dental profession. We find that was true when a three-year course in dental colleges was an established plan of instruction, and we also find the laws in most states were changed to follow the advancement of dental education when four years of high school work and four years of dental college instruction were required.

Some who have followed the trend of dental education for a number of years believe that four years of high-school work and four years in a dental college is a sufficient amount of time to spend in the education of a dentist. However, we find some educators are advocating one year of college work after the student has had four years of high school, before he be allowed to enter a dental school. One year of college work is the requirement in New York State at the present time and one year of college work is also necessary to enter a number of dental schools.

We find some of these schools have made announcements that in 1925 they will require two years of college work after the completion of a four-year high-school course before the student is allowed to begin the four years of study in dentistry. One dean has made the statement that they intend to raise their requirements each year until they eventually require four years of college work before a student can begin the study of dentistry. It has been suggested by others that the student be required to continue his study in dental college two years after completing the usual four-year course, at which time he will obtain a Master's degree. We believe in higher education but there is a point where it ceases to be possible from an economical standpoint.

The great question at the present time is whether such an extensive educational program is going to give results that will be practical and whether a student who has earned a B. S., D.D.S. and M.D.S. degree will possess a sufficient superiority to enable him to render a service to the public which will compensate for the extra expense and time that has been spent on his education.

The final solution to any problem is that of economics. Any educational program which does not render results sufficiently great to pay for the time and money spent upon a student is going to fail. The requirements for the study of medicine have for a number of years been higher than those of dentistry, and a number of men in the medical profession are beginning to wonder if the requirements in medicine have not been raised too high from an economical standpoint. Conditions have arisen which are antagonizing medicine at the present time, that are wholly the outcome of these high educational requirements. So, then, the question of economic value is a deciding factor, not only in medical education but in dental education. If an extensive program of education is carried out which requires two years of college work and four years of dentistry it will compel the student to spend two years more in college during which time he is a liability instead of an asset to the community. He is a liability because he is not earning anything to support himself

or to improve the condition of the people with whom he associates. Someone is forced to pay his living expenses and for his schooling. The living expenses probably come from the student or his family. The education expenses will be borne by the university, which will either be an endowed institution or a state university, or must come from the student's own financial resources.

Consequently, the amount of time and money involved in these two years of college work before beginning the study of dentistry will amount to a large liability which the community or the public is forced to carry. The public should carry this liability *providing it can be proved* that after these two years of college work and the completion of his dental education the student is able to render a return sufficiently great to compensate for the financial outlay incurred during these two years of college work. Medicine has required two years of college work for some time and up to the present time has failed to show a sufficient improvement in methods of practice over the medical student who formerly had only a high-school education and four years of medical school work to justify the additional time.

As a result of the extra two years of college instruction, we find that the number of medical men has been reduced to such an extent that it is impossible to get physicians to locate in small cities. These small communities that cannot obtain medical men remember the day when it was possible to have a physician in that locality who was able to render medical service that was acceptable and satisfactory to the majority of individuals. It is only the exceptional case of illness that requires the attention of a specialist. The usual or the majority of cases can be successfully and satisfactorily treated by a medical man who has only a high-school education and four years of medicine.

By eliminating the two years of college work in the medical course, he will render services to the public two years earlier; it will enable him to become an asset in a community two years sooner and consequently it would be a saving to both the public and the student.

It has also been proved that medical departments of state universities are encountering opposition because of the length of the term and the expense to educate a medical student as compared to other students. We realize that a medical education must necessarily be more or less expensive owing to the required laboratory equipment, but we believe that very satisfactory results could be obtained by allowing the student to take up the study of medicine after he completes four years of high-school work and save the institution and the state the expense of educating him two years in college, which does not give enough superiority to justify the financial outlay or the loss of time.

From the economical standpoint, then, the two years of college work in medicine and one or two years of college work before beginning the study of dentistry is questionable. If this were the only factor to consider, it might be possible to continue this plan to a more satisfactory solution. However, any educational program as regards the education of the profession to be a success must have the backing of the public, enforced by laws. Higher preliminary educational requirements, either in dentistry or medicine will fail unless state laws are enacted in keeping with these requirements.

We already see signs of the public refusing to enact laws to enforce those advanced educational programs because the people have become aware of the fact

that the high educational requirements are working hardships upon the community.

Several years ago the legislature of a western state, because of trouble with the dental board, repealed the dental law for a period of time and allowed anyone who desired to practice dentistry in that state. That was primarily because the dental board had taken an autocratic position and was limiting the number of men that were allowed to register in that state.

We find in Missouri that the legislature has enacted a bill which has been signed by the governor compelling the medical board to examine any medical graduate from a chartered institution. The legislature has changed the entrance requirements so that a student possessing preliminary education, less than the four years required to enter a dental school, can enter medical college and this year one particular medical college has a Freshman class of over two hundred and fifty. This is an actual fact, not a theory. The law was enacted by the legislature because the supply of physicians in Missouri was not sufficient to take care of the public. In the aforesaid state, we know of a number of towns of considerable size without dentists. The inhabitants have a clear recollection of the time they had a family dentist in that community who was able to give them dental service that was satisfactory and they are going to begin to wonder why a dentist cannot be obtained for that locality at the present time. As soon as they realize that dental education and dental laws are limiting the supply of dentists below the demands of the community then the law will be changed.

We are aware of the fact that there may be enough physicians and dentists in the larger cities to properly take care of the public, but the present educational program of the medical and dental schools is one that is constantly driving the men in those professions from the smaller communities into the larger cities.

Dental and medical laws in the past have been sponsored by the professions primarily for the protection of the professions and the protection of the public has been a secondary consideration. Any law to be a success must be of advantage to the public and up to the present time medical and dental laws have been an advantage to the public, but these laws in certain states are fast approaching the point where they are going to work to the detriment of the people. That is why in Missouri, the medical law was changed to lower the educational requirements and enable that state to get sufficient medical men to take care of the residents.

I am aware of the fact that some will say that the lowering of educational requirements is a dangerous procedure, and it is something that the public should not tamper with. Nevertheless, we believe that a physician with four years of high-school work and four years in a medical college is much better in a community than is the chiropractor, neuropractor and the osteopath, who has much less education. As a result of the high educational requirements, we find men who would otherwise make creditable physicians and dentists enter chiropratic, neuropractic and osteopathic schools and will be allowed to practice those professions among the public.

In every large city we find that these "schools" have sprung into existence and they are getting their students, because men are denied admission to medical and dental schools as the educational requirements are too high. In certain states the osteopaths have had the state laws changed to give them the same recognition as the medical man. Bills are being presented to the legislatures

giving this recognition because the osteopath, chiropractor and neuropractor are increasing in greater numbers than the medical men, and it will only be a short time before they will control the balance of voting power and consequently they will have more power with the lawmakers, because any member of the legislature is influenced by the group that can show the greatest amount of votes on election day. Also, if the medical profession goes before the public with an educational program trying to show the shortcomings of the chiropractic, neuropractic and osteopathic schools, they will have great trouble in convincing the public, because it will seem as if the medical profession was working for their personal advancement as if they were trying to form a "medical trust" or "closed corporation," and also because with the present educational requirements they are unable to supply physicians to take care of the people in all communities.

The conditions we have cited in the medical profession today are facts, they are not theories. It will only be a short time until the dental profession will be confronted with similar troubles. Already in dentistry we have a number of "schools of mechanical dentistry" that are sending out attractive advertising matter trying to impress upon the young man and woman the wonderful advantages of a profession. We have examined a number of these advertisements and they are very misleading because after you read the advertisements, you are led to believe that you are learning a profession, when, as a matter of fact, the student is only learning a part of a profession.

We have received inquiries from the Vocational Board in regard to schools of dentistry in New York that were supposed to have evening classes. The Vocational Board had received inquiries from discharged soldiers asking for assistance to enter a certain school in New York that was teaching dentistry at night and upon investigation it was found that the school to which they referred was a school of mechanical dentistry.

In times past we have had a number of medical and dental schools which did have evening classes. Owing to the ruling of the medical and dental educational councils, these evening classes have been discontinued, which may have been a wise thing for all concerned. Nevertheless, we fail to see why medical or dental education should be limited only to day schools when other professions are taught satisfactorily in night schools. The oldest profession probably is that of law. Still we find the legal profession has always been in favor of night law schools and a student who graduates from a law school, which gives instruction at night from the hours of seven to nine or thereabout is allowed the same standing before the law board when he completes the regular course of study as the student who has studied in day school. It is true that the time required for the night course extends over a greater period of time, but as long as a student obtains the required information, we can see no difference whether he gets instruction in the daytime or at night.

The mechanical school of dentistry, therefore, holds out two advantages to the ambitious young men, namely: he can enter a school of mechanical dentistry after three years of high-school training and get his instruction in the evening, thereby making it economically possible for him to attend the school of mechanical dentistry when he could not attend the school of medicine or dentistry. This also applies to the chiropractic, neuropractic and osteopathic schools, which have classes at night, thereby having a

great economical advantage over the schools that give instruction only in the daytime.

This question of day or night instruction is only a small matter but it is a part of the psychology of the public that is going to have a great bearing on the future of the medical and dental professions. As the schools of mechanical dentistry will continue to increase in number and their graduates become more numerous, we will find that mechanical dentists will be of sufficient number to enable them to force a change in the dental laws that will allow them to take impressions, construct dentures and do mechanical work for the patient without the supervision of the dentist. They will be able to present a convincing argument to the public by stating that a mechanical man, if allowed to work without the supervision of the dentist, will be able to render service to the public at a greatly reduced fee. This immediately, then, becomes a question of economics and if the mechanical men can show the legislatures where he can save the public several dollars on each piece of mechanical work, the laws will be changed to enable him to do so. Of course it may be an inferior piece of work to that which would be done by the dentist, but nevertheless that phase of the subject will not be recognized by the majority of the public. Some men have contended that the future of the dental profession lies in having highly educated men with two years of college work. These highly educated men should sit in the office, write prescriptions, and outline the work while the mechanical dentist performs the actual operation. We do not believe this is possible in dentistry because the success of most dental operations depends upon the skill of the man performing that service.

In European countries the dental profession has been divided into two classes, men who have qualifications similar to the American D.D.S. and also mechanical dentists. In Austria, since the war, we find the dental laws have been changed to allow the mechanical dentists to perform all dental operations without the supervision of the graduate dentists, except extracting teeth. In a recent letter from a practitioner in Austria, we were informed that the mechanical men were now working to get the last restriction removed, which would then allow them to perform all dental operations, including the extraction of teeth. These laws were brought about in Austria because there were not sufficient men of the same standing of the D.D.S. to perform the services and also because the mechanical dentist showed the public that they could render cheaper services than the graduate dentist because the mechanical men had less of a financial investment in his education.

We have said before that we were in favor of higher education but this higher education must be on a practical basis. Educational requirements must be such as to allow a sufficient number of students to study dentistry or medicine so as to render the service necessary to the public. If educational requirements are advanced beyond a practical standpoint, they will have the result of creating a medical and dental autocracy in which only a limited number of individuals can take up the study of these professions. Those individuals will be students who have unlimited financial support and consequently can spend as many years in college as they desire. However, a consideration of college students shows that the boy with unlimited financial support does not make the best student. A great many of them enter college, study two or three years and never even complete their course in liberal arts. If they do spend four years in college they have spent enough time

in study, and having an unlimited financial income they go into business. Consequently, the very class of men that can afford this extensive educational program do not follow it because they can get something better.

Also, if educational requirements are raised too high the only other solution will be endowed institutions which will enable students to pursue their education with small financial outlay on their part. This then means that the community or some individual will have to support this educational institution that is carrying on its extensive educational program. The advisability of this had already been questioned by the chancellor of one university and has raised the economical question purely from the standpoint of the university. It was suggested that the number of students that that program would attract would be entirely inadequate to justify the financial outlay necessary to carry it to completion.

We therefore find that the question of expense is being considered by some of the schools that are advocating two years of college work before the study of dentistry. We believe that this problem of dental education and high preliminary requirements will solve itself if the dental profession and the public realize the importance of it. In other words, the educational program requiring two years of college work after the completion of high-school should be tried out by such schools as can financially afford the experiment.

If after a number of years we find that their graduates are rendering a service to the public far superior to the schools that require only four years of high school and four years of dentistry then the public can so change the laws as to force this educational standard on all schools. The present educational requirements of dentists seem to be about as high as possible and yet remain an economical success from the standpoint of the student and the public. If it goes any higher and becomes impractical then laws will be changed, educational requirements will be lowered, dental mechanics will be recognized and the conditions will be worse than at the present time.

We are aware of the fact that the dental profession, during the past few years has taken very little interest in dental education believing it was a matter which should be left to the dental colleges. However, owing to the fact that certain dental schools are advocating an educational program that is liable to cause much harm, the dental profession should take some interest in the matter. And, furthermore, owing to the fact that schools of chiropractors, neuropractors and osteopaths and numerous other cults have sprung up, the medical profession is confronted today by a very serious problem and the dental profession may have the same problems if they are not careful in regard to their educational program.

We believe that the success of the dental profession is controlled by the three things we have mentioned: dental education, dental laws, and the public.

ORAL HYGIENE LECTURE TO NORMAL STUDENTS

By G. D. EDGAR, D.D.S., Defiance, Ohio

(Read before the National Dental Association, Milwaukee, Wisconsin, August 15-19, 1921)

EDUCATION today is not merely the application of the principles and rules as found in the textbooks of our public schools, but it consists of everything that pertains to the life, health, and happiness of the individual.

In the past the dental and medical professions have been derelict in their duty to the public by not taking a more active part in the health and welfare of the children in the public school.

Mouth hygiene is the subject that the dentist is particularly interested in, and it means anything that has to do with cleanliness or health of the mouth.

For a number of years the dental profession has realized the necessity of proper instruction to the public in mouth hygiene, anatomy, nerve and blood supply, functions of the teeth and adjoining parts, and their relation to other parts of the body.

The profession sees the need of short lectures in our schools, for it realizes from experience that many of the children's mouths are in such an unhealthy condition, presenting decayed teeth, abscesses, and disease germs, that dullness in their studies is often traced as the result.

If the importance of correcting tooth defects at an early age was more generally recognized by parents and teachers, there would be less of harmful influence of the school on eyesight, and the number who pursue the course to the end would be materially increased. Many parents, tho interested in the welfare of their children in all other respects, neglect this important duty, notwithstanding the fact that a large number are below the average in the class. Parents are negligent, too, of the fact that earache, weak digestion, headache, and physical breakdown are many times due to some defective tooth or teeth. It is well-known that many nervous wrecks, who are supposed to be invalids from inherited causes, have inherited only defective mouth conditions, which like those of their parents have not been corrected.

We have often wondered why the school authorities insist on music, domestic science, language and agriculture being taught in our schools, and then practically neglect the health of the child, the foundation that is required to make use of any subject taught in the schools.

In speaking on the subject of mouth hygiene, we as dentists do not claim that the mouth and teeth are the cause of all ills; but we are prepared to prove that the major part of all diseases arises from bacteria or germs that are primarily found in the mouth.

It is absolutely necessary to have a good set of teeth and in correct position in order that the food may be properly masticated or ground up, and it is further necessary for the food to be prepared in the proper way so that the stomach will not have so much work to digest it. If the child has sore teeth caused by decay or ulceration he will not grind the food to the proper fineness, but will soon form the habit of bolting the food. Since the stomach can perform this extra amount of work for only a reasonable time, indigestion will surely follow. Without thoro mastication, there can be no good digestion, and without

good digestion there can be no good assimilation of the nutritious properties of the food which is necessary for building up the bodies.

Figure 1 shows the temporary teeth in position and the permanent teeth forming in the jaw. There are ten temporary teeth in the upper and ten in the lower jaw, five on each side of the upper and five on each side of the lower jaw. Nature has provided us with sixteen permanent teeth on the upper and sixteen on the lower jaw, and expects us to use good sense in their care and preservation.

The first tooth of the second set is

Fig. 1

erupted about the sixth year and comes back of all the temporary teeth, as is shown by the vertical line. This tooth is the most important one in the mouth, because later in life it is found in the middle of the jaw. If lost the jaw will not be expanded and the contour of the face will be destroyed.

Figure 3 shows how a set of teeth should articulate to give the food the proper preparation for digestion. An unhealthy mouth is caused primarily by uncleanliness. Particles of food lodge between and round the teeth, and bacteria or germs find there the proper condition for growth.

There are germs in the mouth that produce acids by action on sugar and starches. Decomposed food and acid acting on the lime salts, of which the teeth are largely composed, destroy nature's structure of the teeth and produce decay.

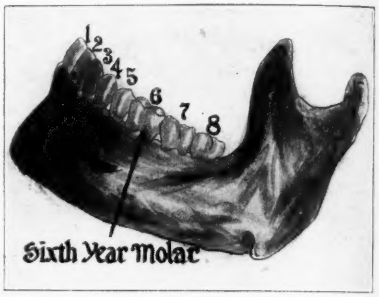

Fig. 2

The enamel and then the dentin (Fig. 3) are destroyed and finally the nerve exposed.

Each tooth has its own nerve and blood supply (Fig. 3) which enters the apex of the tooth, and this nerve and

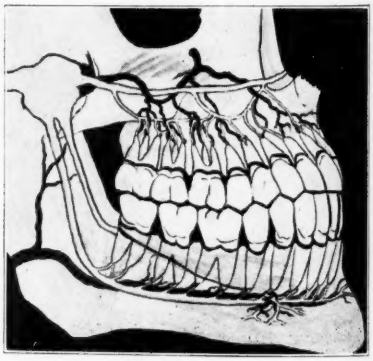

Fig. 3

blood supply is connected with the entire nervous and circulatory system of the body. Thus germs that are found in the mouth thru a decayed tooth may reach the circulation and nervous system, and afterward all parts of the body.

Germs that produce pus are found in the mouth. On entering the tooth they act on the nerve. In decomposing, gases are formed which must find means of escape or poison the system. In following the road of least resistance, which is thru the apex of the tooth, the germs force their way along side of the tooth, and finally break thru the thin alveolar process. The honey-combed bone forms the socket of the tooth, and a real abscess is formed. Proper drainage must be established to prevent these pus germs from entering the circulation, or much depends upon the degree of immunity the body possesses to conteract their effects.

Most authorities claim that diseases of the heart, kidney, and liver, as well as rheumatic conditions, are brought about by these infections.

Any child who is troubled with toothache or ulcerated teeth or tonsilitis, or adenoids, or any disease that affects the nervous or physical development of the body is not in a proper condition to develop the mental faculties to the standard of one of its age not so afflicted.

The goal which educators of today are striving to reach in the work with the child is, "A strong mind, and a strong body," and to that end they approve of athletics and gymnasium work.

What are the different states doing to assist the weak child to develop good health? I find that in Ohio they are paying $10.00 a year for teaching ancient history, $8.00 for modern history, $7.71 for Latin, $8.13 for Spanish, and $0.80 per pupil a year for teaching physiology, the only subject that has to do with health. Statistics show that 20 per cent of the children in our public schools fail to pass. That means 240,000 in Ohio, and to give them an extra year in school would require 8,000 teachers, allowing one teacher for thirty pupils. The minimum wage is $800 necessitating an expense of $6,400.00, exclusive of the cost of equipment or the upkeep of the school.

Is it not time for the state to ascertain the possibility of expending a part of that amount toward preventing the leak by the use of hygienic measures that will enable the child to be advanced instead of being retarded in his studies? It has been proved that in schools where mouth hygiene measures were introduced the percentage of failures was reduced from 47 to 19.

The great idea underlying all instruction to the child should be to stimulate his interest according to his individual ability. When a pupil is not producing

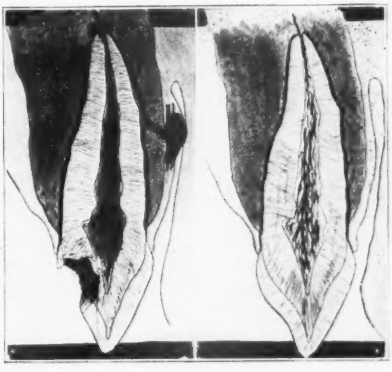

Fig. 4 Fig. 5

satisfactory work, an interest should be taken in him and to ascertain, if possible, if he is suffering from toothache, earache, pains in the eyes, or any disease that would render him unable to keep up with the class. Many children are either underfed or overfed, and their food is not the variety that would build a well-formed body. Others live in homes that are poorly ventilated and poorly lighted with no regard for sanitary measures. Coming from such conditions they help contaminate the atmosphere of the schoolroom and may help spread disease to the community.

The teacher is the first one that should be enlisted in this great work, so that when a bill in the Legislature is introduced the school organizations will give

their support to the boards and the Legislature in approving and adopting mouth hygiene and medical inspection in the schools.

Physiologies should be rewritten to make clear these important subjects and in terms that could be understood by the pupil and easily explained by the teacher. Short lectures should also be given by the profession showing the necessity of retaining health by means of good teeth.

School boards say that the plan is feasible but that they cannot put it into operation for three reasons: (1) the public will say it is in the interest of the dental and medical professions; (2) it would be intruding on the personal liberties of the child and parent: (3) there is no money.

1. If the dental and medical professions wanted more business, they would certainly let the public remain in ignorance of the laws of health because this will produce more business than anything else, while teaching hygiene would preserve health.

2. Personal liberties. The parent sends the child to school and he follows the course of study as given by the school authorities thru the grades. On entering high school, he is asked if he expects to go to college; and if so it will be necessary for him to have certain credits in geometry in trigonometry and in some foreign language, and no one questions it because it is demanded by the colleges. Perhaps the day will soon come when the colleges will demand that when a student applies for admission he will be required to know how to preserve and maintain health.

3. As regards the money, it has been proved at the Marion School at Cleveland that it costs ten times as much to carry a child an extra year in school as it does to fix up his teeth.

Discussion

Louis Ottofy, Manila, P. I.: It was my privilege to make the first examination of the teeth of school children ever made, as far back as 1882, nearly forty years ago, the report having been published in the *Transactions of the Illinois State Dental Society* in 1883. Since then, I have made examinations in this country, in Japan and the Philippines, including lepers and some of the wild tribes like the Igorotes and Negritos. I have personally examined and tabulated the condition of over 700,000 human teeth. I am of the opinion that so far as the children are concerned, nothing further may be gained by the examination of the teeth, but improved conditions may be noted, by comparison with the conditions in the past. What is now of greater importance, is to ascertain the condition of the teeth of adults, and thereby draw the attention of the people to the deplorable condition of the teeth of the vast majority of the inhabitants of the United States. I suggest a unique method to commence this work, by securing group examinations; and as the first of them, the examination and the tabulation of the condition of the teeth of the members of the National Dental Association. Here we have a group of individuals among whom the teeth should be found in as good, or better condition, than in any other group, profession or trade. As fillings, crowns, bridges and dentures would be recorded as repair of damage, the final statistical report will show how extensive that is, among those who are assumed to take the best care of their teeth, and are at all times in a position to make the necessary repairs. This may easily be accomplished by sending out postal cards with the copy of the Journal, on which every member is requested to fill in the chart showing the condition of his own mouth. With this as a basis, there would be no difficulty to have other professions, like the medical and legal; of trades, like bakers, steelmill hands, etc., to have examinations made thru their associations, unions, etc. If the 30,000 members of the National Dental Association reported the condition of their own teeth, we would have approximately 900,000 teeth reported on; some present and perfect, some repaired, some lost, some replaced. If it should be shown, for instance, that in this profession, (dentally speaking the most advanced of any group of individuals), only 20 or 30 per cent of the teeth are perfect, while the remaining have been either repaired, or their loss replaced, what might the condition be in other groups? This opens a wide field, viewed from any standpoint. Should it be found, for example, that in some group the percentage of sound teeth is thirty, and the repair and replaced loss represents 30 per cent, what about the other 40 per cent, which must be either decayed or lost and not replaced? In any event, the examination of our own teeth would be of profitable interest.

THE IMPORTANCE OF ORAL DIAGNOSIS FROM A MEDICAL AS WELL AS A DENTAL STANDPOINT

By DON M. GRAHAM, M.D., D.D.S., Detroit, Michigan

(Read before the National Dental Association, Boston, Massachusetts, August 23-27, 1920)

WITH the exception of these especially trained and particularly interested in mouth conditions, the oral cavity is a sort of "no man's land" to the general practitioner of medicine and dentistry. The physician's familiarity with it consists mostly in an occasional inspection of the tongue, as a diagnostic sign for some systemic disturbance, while the dentist far too frequently confines himself just to repair of teeth.

The frequent pathologic disturbances (21) in the oral cavity, many of which are overlooked until too late, would seem to compel the necessity of either physician or dentist assuming guardianship over this important and vulnerable gateway to the human organism. It is obviously impossible for the oral surgeon to have under his observation the thousands of people, in any community, who regularly visit their dentists, as it is perfectly plain that the logical person to keep a watchful eye on general mouth conditions is the dentist. It is not expected that he should be able to correct or even pass final judgment on all these early manifestations, but it is imperative that he be able to detect deviations from the normal and intelligently refer them for diagnosis or treatment if he cannot or prefers not to do so himself. The soft tissues are subject to such inflammatory changes from contusion, abrasion and general infection that it is often difficult to say definitely whether we have a malignancy or not. Who is better situated and equipped to observe and judge mouth conditions than the dentist, since he has constantly the mouths of his patients under observation? It is common knowledge that the physician is quite incapable to pass judgment on these cases. The number of lives sacrificed on account of this divided responsibility is startling, and the odium cast upon the dentist for not recognizing these conditions is more than is generally admitted. Not frequently we hear patients declaring that the pathology began after a visit to the dentist for the insertion of a bridge, or the removal of a root, and generally this belief is concurred in by friends, and occasionally, by physicians, when, as a matter of fact, the pathology was already present but undetected by the dentist, who nevertheless is guilty of contributory professional, if not criminal negligence, in not detecting the condition. We have seen so many such cases where the dentist was held responsible for a condition, while in reality his inadequate equipment for making an early diagnosis or at least his neglect in expressing his suspicions and intelligently referring the case was his real sin. The latter course would add greatly to the comfort and safety of patients as well as to the credit of the dentist.

This inability or refusal to make a diagnosis of mouth conditions, other than purely dental, is, we believe, the real underlying reason why a physician dares

refer or treat a purely dental case without first consulting the dentist in charge. The lack of professional ethics in this respect is most flagrant and humiliating, and can be explained on no other ground. When we consider his multitude of duties and the many ramifications of mechanical dentistry of today, it is not surprising that the major part of the dentist's efforts is given up to restorative work of dental structures, leaving very little time for consideration of the other tissues of the oral cavity. This, however, in no way excuses the dentist for ignoring the pathologic in the oral cavity, for in so doing he will sooner or later learn to deplore his remissness in this important duty.

A report of a case in practice will make more plain, perhaps, what we have in mind: A patient presented herself to her physician, with some toxic symptoms, a hemoglobin of 50 per cent, and with a profound physical depression. After some weeks of constitutional treatment, to no avail, it was found that she had a few devitalized teeth, and some pyorrhea. She was referred to her dentist who extracted the few loosened teeth. Finally she was sent into the hospital for observation, where it was discovered that she had in the extracted areas of the lower jaw a pathologic condition, which was assumed to be necrosis. The oral surgeon was called to care for this condition, which the patient and her relatives stoutly contended was the result of extraction and carelessness on the part of the dentist. As it showed strong evidences of malignancy, the oral surgeon refused to undertake the operation until a laboratory report could be had on the suspicious tissues. The report showed advanced malignancy and when cauterization of these areas was undertaken it was found that involvements were deep and varied and altogether beyond help. The patient and her friends maintained until the last that the dentist, in some way, infected her jaws. Had the dentist some familiarity with pathologic mouth conditions, he would have at least reported his suspicions, saved his own reputation, if not the life of the patient. By familiarizing himself with the normal, and observing closely the color, contour and characteristics of the different soft tissues of the mouth, he would soon learn to detect the abnormal with the result that much unnecessary suffering would be avoided and many lives saved. It is not to be inferred that it is always an easy matter to make a diagnosis of mouth conditions (2). Indeed in many cases it is most difficult, but to totally ignore the most obvious mouth lesions is inexcusable in the practice of any member of the healing art. When dentists shall have assumed real guardianship over the mouth, as shown by their ability to early detect the abnormal, the physician shall cease to order the removal of an orthodontic appliance, the extraction of a tooth, or refer for treatment to other physicians the dozen-and-one other conditions that rightfully belong to dentists and dental specialists. If it is right for a dentist to refer a dento-alveolitis for extraction, a gingivitis for treatment, or a malocclusion for correction, is it not also right and reasonable that he should intelligently refer any other pathologic mouth condition for its correction, if he does not care to undertake it himself?

A diagnosis is not worthy of the name unless it takes into consideration the history, both personal and family, as well as the history of the disability under consideration, the date of its onset, and so forth.

The incident of a root-canal treatment and the onset of an arthritis within the same week is not without significance. It is superfluous to add that very complete case records should be kept of the patient, for at least two years, if he has been treated for oral focal infection, if our clinical data is to be of much value.

If we are to render the best service to our patients, and to assure accuracy and dispatch, we must necessarily proceed in some systematic and more or less routine manner. In a "mouth examination,"

which is a very much better term than "dental examination," the lips would first attract our attention. The color, contour, and general health of these tissues should be determined. If abrasions be present their history and cause should be ascertained, whether specific or mechanical, and, if mehcanical, whether its causation be a tooth or dental restoration.

The vestibule should be examined for evidences of leucoplakia, buccal cysts, or potency of salivary ducts, all of which can readily be ascertained, and many times shed a flood or light on some otherwise obscure pathology about the jaws. The odor (3) of the breath is also of great importance and should not be overlooked, as some systemic diseases can often be suspected, if not actually detected, by the breath alone, while in local conditions its character is not to be ignored in making a diagnosis in suppurating conditions.

The teeth and supporting structures will naturally next claim the dentist's attention. Little can be added to the progressive dentist's armamentarium for the routine examination of tooth structure. Too much reliance, however, has been put on radiography in passing judgment on a tooth under examination. A more general use should be made of percussion, palpation, thermal stimulation, and more especially electric stimulation. As a matter of routine, each tooth should be tested by the electric current. So many canals have been left unfilled, while in other instances, apparently, so little resorption of apical tissue has taken place about devitalized tooth that it is impossible to say radiographically whether a tooth is vital or not, regardless of the fact that this latter agent is undoubtedly the best single diagnostic means at our disposal.

With vital teeth, altho no subjective symptom be present, every means should be taken toward the detection of early caries that its early repair may prevent pulp destruction, and subsequent trauma (10) and infection (29), which are undoubtedly the underlying causes of most of our oral sepsis. With crowned teeth it is obviously impossible to test them electrically. Where the patient's health is involved, and other diagnostic means exhausted, we are justified in removing the shell crown, or any other dental restoration if necessary, to determine the vitality of a tooth not above suspicion. The assurance that the work was done by some prominent dentist or under unusual precaution, or according to the very latest approved method should be overruled, for such statements are often advanced by sensitive patients who, fortunately we believe, are comparatively few in number (5).

The dentist's devotion to purely tooth examination and tooth repair is almost above criticism, but the same cannot be truthfully said about his interest in the surrounding soft structures. In the latter regard we confess that the oral surgeon is not always blameless. The frequency with which a pyorrheal pocket has developed under our supposedly careful treatment and closest scrutiny, and the numberless times that a pyorrheal infection has been overlooked in our routine examination of referred patients has led me to be more than generous in my criticism of this really inexcusable dereliction, especially with patients whose time and means have been placed at our disposal. Undue emphasis undoubtedly has been placed by the oral surgeon on the dangers of apical infections, with an almost total disregard of probable dangers of pyorrheal conditions in the same mouth (23). Only by the most careful exploration by suitable instruments, as well as by the employment of radiography, in suspected cases, can acceptable diagnoses in these cases be obtained. While we are in a chastened mood, it might be fitting to add that much of the criticism that is now being directed against dentists who make diagnosis by radiograms alone, and who read into them all kinds of fantastic pathology (14), could apply to many oral surgeons a

few years ago, when the limitations of radiography were not so well known as they are today.

We repeat that the dentist should so familiarize himself with the normal mouth, by examining every patient that enters his chair, until the abnormal attracts his attention with that distinctness and directness that a discolored or a supernumerary tooth does. We do not believe, as has been advocated by some, that special courses in mouth lesions are imperative, altho no doubt helpful, to the detection of the abnormal. By becoming intimately and daily acquainted with the normal in the mouth, as the dentist can, it is unbelievable that any serious pathologic lesion should escape him. It is not expected that he should pass final judgment on all suspicious deviations, but he should at least be able to intelligently refer the case if he should feel insufficiently qualified, or disinclined to care for it himself. The gingival tissues excepted, it is safe to say that 95 per cent of soft tissue of the mouth are normal or near normal, and for this reason we suggest the diligent routine study of patient's mouths as they present themselves, that a deviation therefrom may be early and easily recognized, to the very great benefit of the patient as well as to the everlasting credit to the dentist.

Unfortunately, until very recently, the dentist supposed he had no health problem, except that of mastication. True, he had local pathologic conditions to contend with, but they were considered purely local, and their local corrections, as well as his dental restorations, was almost an exact science. With the revelations of Hunter (18), Billings (3), Rosenow (30), Hartzell (15), Moorehead (26), and others, his status to the healing art was changed overnight. It was but natural that some physicians, as well as dentists, should go to ridiculous extremes. When cases of ill-health yielded or apparently yielded to removal of oral foci, they rushed to print and maintained that all ills and aches were caused by oral sepsis. Too many physicians accepted the oral sepsis theory as a lazy means of diagnosis, altho they ought to have known that there is not one cause, but a thousand and one causes, for ill health. Too many dentists immediately seized upon it as an excuse to rid themselves of a great deal of discouraging and difficult root-canal work for the more easy extraction alternative; while very many truly conscientious dentists were and still are driven almost to distraction at the root-canal situation. As Nature's law of contrast compensation is ever working, a few physicians (2) and dentists (17) have as stoutly maintained that there was no evidence forthcoming that oral sepsis ever caused systemic disturbances. In these contentions, both unwittingly served the useful purpose of helping to counteract somewhat these ridiculous extremes.

How often have dentists left a meeting, totally discouraged? How often has the truly conscientious dentist resolved to himself after treating pulpless teeth and inserting some dental restoration, which was later condemned, that he was done with it all for all time? Have dentists valid reasons for discouragement with the present unsettled status of the pulpless tooth? Do the uncertainties of dentistry compare so unfavorably with those of medicine for instance? Granting that we do not know how to safely and effectually care for so artificial an operation as the treatment of a devitalized tooth, how does our inability in this respect compare with the physician's in his treatment of general pathologic conditions? What for instance does the physician know about cancer (25)? Almost nothing. What about pneumonia (28)? No known form of treatment, medical or otherwise, modifies its course materially. What about tuberculosis (20)? Only in one state of the Union (Massa-

chusetts) has it shown much abatement. No headway has been made against cardiorenal or cardiovascular conditions (9). Practically no advance has been made in the treatment of chronic nephritis, and what the ablest internist can tell us about abnormal blood pressure, and about arthritic conditions (1), generally, could be written in a few short paragraphs. For these disabilities there are no specifics, merely attempts at adjustment. The whole question of focal infection is as little understood by the physician as by the dentist. The important thing is that our knowledge is gradually, if slowly, increasing. "The more an internist knows about focal infection, the less he thinks he knows," is an Hibernicism that well expresses the situation. We might add that the converse would seem to be equally true: "The less a physician or dentist knows about focal infection, the more he thinks he knows." Are physicians disheartened and utterly discouraged? Not by any means. Regardless of their many unsolved problems, they have so much to their credit that they go cheerfully to their duty of relieving suffering and prolonging life. The dentist's future was never so bright, altho he has his medicodental problem (24) of oral sepsis to settle (4). When solved his past achievements will vanish into insignificance, when compared to these future accomplishments. That the exact status of oral focal infection will not be definitely determined for many years seems certain, but there can be no doubt that dentistry will have gained immensely in prestige when it will have been accomplished, for it is inconceivable that any great progress can be made without the active co-operation of the dentist in establishing the relation of oral sepsis and systemic disturbances.

What shall we do with the devitalized tooth in the meantime? We believe we can safely say: "To date the status of the devitalized tooth has not been determined," and that it will require thousands upon thousands of tabulations by our most careful observers before a conclusion can be arrived at. That it is a direct and primary cause (27) of some of the disabling and indefinite conditions, there appears to be abundant clinical evidence; that it is a contributing cause (11) to a great many distressing systemic conditions is even more apparent. Enough is known to permit us to say that neither a diagnosis nor a prognosis should ever be made on purely local conditions. For this reason we contend that a broader conception should be held of the term "dental diagnosis," if indeed that term should ever be used.

Summarizing with a quotation from a former paper (12) we repeat:

> It must be remembered, from a clinical standpoint, that there are a great many possible focal centers in the body, such as tonsils, accessory sinuses, the intestinal and genitourinary tract, as well as many others. The ablest internist, even after the most careful method of elimination, cannot always state definitely which focal area is causing the constitutional disturbance. Indeed, this disturbance may be the result of many focal areas, and this naturally adds to the difficulty of saying very definitely whether the teeth are the whole cause or only a contributing cause. Indeed they frequently are in no way the cause of the systemic disturbance, even when symptoms point strongly to such a possibility.
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> Sufficient clinicial data is at hand to permit us to state very positively however, that under certain systemic conditions, (16) patients should not harbor devitalized teeth. If a patient shows a hemoglobin count below seventy, which cannot be accounted for as temporary, we are not justified in placing an additional burden upon such a patient for we know that a great many anemic patients have been completely restored to health after removal of some dental infection. It should be part of the routine examination, where devitalized teeth are retained, to know beyond a doubt that such a patient is not suffering from anemia. This can be done very simply by the use of the hemoglobin chart if a pathological laboratory is not available or if this data cannot be had from her physician. If it is found, for instance, that the blood smear registers only sixty-five when compared with the chart, it is the duty of the dentist to ascertain whether this is of temporary origin, such as pregnancy, or due to a recent acute illness. If not, he is not justified in adding further to this toxemia.
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> It is the consensus of opinion that by far the greatest proportion of secondary infections

have their origin in the tonsils and oral cavity, and that the septic tonsil, if not equally guilty in causing systemic conditions, is a very close second to mouth sepsis as an origin for secondary infections. That they are generally operating together to the disadvantage of the organism is recognized, and relapses are sure to follow unless both septic areas be eliminated. The dentist can make a very intelligent examination of the tonsil with a little training, and in passing judgment on a devitalized tooth he should examine the tonsil as a matter of routine to see whether or not it be in a pathologic condition. If the patient should refuse to have a diseased tonsil removed, it would then be the part of wisdom for the dentist to refuse to place any restoration on a devitalized dental member for such a patient.

When a patient shows a tendency to "rheumatism" or a tendency to easily "catching cold," under no circumstances should he be compelled to carry the additional load of a possible dental infection, for at some inopportune time this apical area is very liable to become hematogenically infected and a crippled condition is not infrequently the result.

It is now generally conceded that rheumatism is the result of infection and trauma, and anything that adds to the sum total of this infection will be a menace to the patient. In no part of the body do we find trauma and infection so frequently associated as about the devitalized tooth. Nor should patients showing abnormal blood pressure be asked to undergo the possible dangers that are incident to the retention of devitalized teeth. Abnormally low blood pressure is contraindicative quite as much as hypertension, both conditions being usually the result of a toxemia or infection. Clinical experience has time and again shown that focal infections of dental origin are frequently contributing factors in abnormal blood pressure. It is doubful if, in themselves, they are often the sole cause but rather add fuel to the flames that are already consuming the organism. With a little training and practice, any dentist should be able to estimate approximately, at least, the arterial tension of the patient and be guided accordingly, for there is probably nothing that so constantly affects the pressure of the blood stream as focal infections of one kind or another. Their elimination is the logical procedure wherever they be found, whether it be an appendix or an apical area. Other systemic considerations might be mentioned, such as the estimation of renal content, but our intention is not, however, to presume on the domain of the physician, but only to equip the dental practitioner in a few practical everyday diagnostic procedures which will enhance the value of his services to his patients. Incidentally it will place him on a higher plane in the esteem of these patients. If closer co-operation of physician and dentist is imperative in dealing with cases, simulating septic absorption, and if the dentist must know something about general pathology, the necessity of a broader conception of the term "dental diagnosis" must be self-evident to all.

However, the dental diagnostician dares not be too positive in his prognosis based on the removal of oral sepsis (13). So many factors enter into the question of general disability, and the causes are so varied and so numerous that it would be very hazardous to say with any positiveness that with the removal of oral sepsis, however, an arthritis, a myositis of an iritis would clear up (31). It is common observation that practically any and all forms of physical disabilities, of the septic type, show some improvement after eradication of oral sepsis. This being true it permits the dental diagnostician to say with assurance that, on general principles, devitalized and doubtful teeth of such patients could be removed with advantage. If we have some advanced pathology, such a nephritis, a carditis, or advanced chronic arthritis, the chances are greatly that relapses will follow in such cases. Even with early improvement, a guarded prognosis should be given as to permanency of results. There is no doubt but that these frequent early improvements gave reason for false hope, and led many into the common error that oral sepsis is the case of most

of our physical disabilities. Undoubtedly many relapses resulted from too conservative treatment in the way of root sterilizations or root resections and lack of curettements.

Regarding the advisability of root excisions (22) being ever underaken, we would say experience would seem to demonstrate that only with the most suitable and well-selected cases should it ever be attempted, and never when a patient is below par or showing evidences of ill health.

Regarding curettements after extractions, there appears to be a division of opinion from extreme alveolectomies (32) to positive refusal to ever curette. I believe that all apical areas of extracted devitalized teeth should always be examined by small suitable curettes, and unless the alveolus be found smooth and osseous, curettement should be made with the same care and delicacy that decayed and leathery dentin would be removed from the cavity of a vital tooth, and with much the same style of instruments. The surgical principle of paralleling the walls of a septic wound, to allow drainage, applies with the same force in the oral as well as the canal cavity. There are undoubtedly a few extreme cases where alveolectomies are indicated, but not as a general principle in the extraction of pulpless teeth. The contention that these teeth sockets should never be curetted is as unscientific as is the statement that they can be successfully cared for by ionization. Conservative surgical removal of granulomata by suitable curettes is the method of choice in our opinion.

If anything would tend to convince one that a broader conception of the term "dental diagnosis" is imperative, it is the hundred and one questions that are being asked the dental internists who are doing any considerable amount of this work. Based on the results of hundreds of clinical cases, seen in co-operation with medical internists on experiences gained as the oral sepsis member of a large hospital clinical staff in group diagnosis of patients sent for observation, and on the reported experiences of careful dental and medical observers thruout the country, we would hazard the following without any claim of finality or originality: oral sepsis is seldom the sole and only cause of ill health. Oral sepsis, and especially the devitalized tooth, is frequently a contributing cause of general ill health. In the absence of tuberculosis, anemia and organic disease, the symptom complex of fatigue, myositis (especially torticollis), and presence of pulpless teeth, speaks strongly for oral sepsis as the causative factor. In cases of chronic ill health, and even with the knowledge of some other definite pathology, the removal of pulpless teeth is sometimes advisable. A guarded prognosis should always be given and the patient should be made to share this responsibility in removal of teeth, as our present knowledge is inadequate to state definitely the status of these conditions. Contrary to prevailing opinion, patients admire frankness and honesty in the giving of a prognosis. With a frank and guarded prognosis, the difficulty will not be with patients refusing extractions, but rather in preventing ruthless extractions of teeth above suspicion. With the unsettled status of the pulpless tooth, and the oral sepsis question generally, it is only fair that patient and diagnostician share the responsibility in regard to the wisdom of removal of certain teeth. Where we have advanced pathology, (8) such as nephritis or a carditis, as evidenced by edma and dyspnea for instance, only such teeth as would plainly afford local comfort should be removed. Nor do we believe it the part of wisdom to extract in wholesale fashion, as is customary, devitalized teeth that are doing faithful masticatory and cosmetic service in persons, say, over seventy, when such a patient is enjoying the health that is commonly enjoyed by persons of such years. In a word, rare good judgment is

demanded in dealing with advanced years, as well as advanced pathlogy if pulpless teeth be present, as more than good may result from such extractions.

Sufficient, we believe, has been said to justify the earlier statement that the dentist should take a broader view of his professional duty. If he is to render the best possible service to the community, he must not only take a keener and a more serious interest in general mouth conditions, but he must also acquire some familiarity with the most obvious, everyday aspects of general pathology. If he is to become the useful and indispensable member of the healing art, to which the importance of his profession justly entitled him, he must outgrow the narrow limits which this profession heretofore bound him.

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THE FULL LOWER DENTURE: A CRITICISM OF PRESENT METHODS AND THE SUBSTITUTE OFFERED

By ELBERT BRITTEN OWEN, D.D.S., St. Louis, Missouri

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FOR a number of years I have been of the opinion that some of the principles incorporated in denture construction were erroneous, and several years of exclusive practice in constructing dentures and observing the effects of their use has proved conclusively to me that certain practices are harmful, and, if followed persistently, are actually disastrous to the foundation for artificial dentures. I have, therefore, reason to believe that these principles are erroneous and unscientific.

Statement of Erroneous Principles

My efforts to secure such a strong adhesion in lower dentures that they could be removed only with difficulty has caused me more trouble than any other part of my work. In the earlier years of my practice as a specialist I held that condition to be an ideal desideratum in a lower denture, and worked faithfully to that end, but the only cases handled in such manner that have been satisfactory are those cases which were constructed at clinics, and which I never saw again after having placed the dentures in the mouth.

Extreme adhesion is never retained and is not desirable on the lower jaw, as it is too severe a strain on the small area of surface covered. Such adhesion is obtained only by extreme tissue compression, which the tissues resent, causing unnecessary resorption, atrophy of the soft tissues, and ultimate bone tissue destruction.

Border compression is harmful, and is even worse than total compression, as it reduces the area of compression; and the smaller the area, the sooner destructive change is caused in the tissues. This square area comparison accounts for the fact that strong adhesion obtained thru compression on the upper jaw will last longer than on the lower jaw. Border compression is permissible, however, on the posterior margins of upper dentures, provided it is done with moderation; but this procedure, commonly known as postdaming, has been largely overdone. In mandibular cases, where submucous tissue is missing and the bony structure is covered only by a thin, tightly drawn mucous membrane, this compression is positively injurious. In practicing this method of tissue compression, one is compelled to be constantly making adjustments, changing the border, and eventually, when the tissue has been absorbed by the compression, the denture becomes loose, the patient is dissatisfied, and the operator is compelled to resort to the practice of "bushing" dentures and "chasing" tissues. By "chasing" tissues I mean the continued following up of changes which take place in the

mouth, to be treated in the same manner as when this change occurred in the first place. I do not believe it is necessary to be constantly refitting dentures, and I feel that it should not be done; especially should it not be done in mandibular cases. By this assertion I do not mean to condemn entirely the practice of refitting dentures, as this procedure is sometimes necessary in treatment cases to serve the patient until a time when so-called permanent dentures may be constructed; but it is of little use in the case of permanent dentures to continually follow up this procedure merely to secure renewed adhesion for it will gradually destroy what foundation is left for a denture. Nothing in the foregoing statement should, however, be construed as opposing tissue placement under certain conditions.

Another erroneous method of securing adhesion is the extension of the border of the denture beyond the point where it can be endured permanently, and especially is this true of the lower lingual cuspid region and the mylohyoid region. This extension, when carried beyond a point of endurance, must be trimmed off from time to time, causing annoyance and expense to both patient and operator, and then such retention as was previously gained thru this undue extention has been lost. The normal structures of the mouth, particularly of the lower jaw, should be only slightly displaced, and the impression technic should be designed to meet this condition.

The position I take is one opposed to extreme adhesion in the lower denture and the two methods used in securing it, viz., compression of tissues and undue marginal extension. It will be understood that adaptation without compression, plus proper extension, will almost invariably give some adhesion, most of which is retained indefinitely if the occlusion is kept balanced, and in such case very few marginal adjustments are necessary. In many cases where dentures have been worn for years, sometimes from twenty-five to thirty years, with no apparent tissue change and no inflammation, there is seldom very much, if any actual adhesion, and while these old-time dentures are not by any means of ideal construction, lacking in many instances both adaptation and extension, as well as occlusion, I nevertheless believe they are better dentures than some that are constructed today, because they present no destructive process of the tissues. I believe it is possible—in fact, I know it is not only possible, but practicable—to construct lower dentures that are comfortable and efficient, that maintain stability during the legitimate uses that throw the greatest strain upon them, and that do not have to be constantly trimmed and adjusted. I can make this statement more definite by saying that it should be necessary for but 50 per cent of the lower dentures to be touched after being placed in the mouth, and in the other 50 per cent the adjustments should be reduced to the minimum. The extension and border adjustment which make this result possible are governed and controlled by the impression technic.

What Should Be Expected of a Lower Denture

A lower denture should maintain stability during all legitimate usage, in connection with the position of the structures, which offers the greatest resistance to stability. The denture will, in most instances, possess moderate adhesion, and should be worn with comfort and without having to be constantly altered and adjusted.

Statement of Fundamental Principles

The following principles are involved in producing the desired results: adaptation, extension, border adjustment, little or no displacement of tissue, favorable application of leverage arch formation, occlusion and articulation. These fundamental principles are so

thoroly understood that they need no particular discussion, except to add that they must be incorporated in every denture constructed and by a technic so simple that anyone of ordinary skill may make use of it.

Credit Where Credit Is Due

The late Loomis P. Haskell, of Chicago, and George H. Wilson, of Cleveland, were, so far as I know, the first kansas Dental Association practically the same technic that is used now. In the development of this work the earlier efforts were, however, handicapped by lack of definiteness and precision, and it is this definiteness and precision that I hope to inject into this tehcnic—definiteness and precision which will enable the operator to construct dentures for out-of-town patients and send them

1 2 3

Figs. 1-3.—Fig. 1, snap impression position, unduly displacing structures. Fig. 2, mouth open, tongue protruded, offering greatest resistance to retention. Fig. 3, abnormal and drawn opening of mouth which would be guarded against.

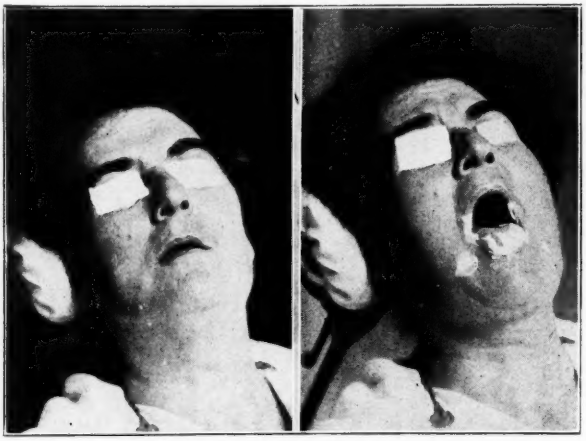
operators to make use of the principle of extension without undue displacement. I am personally indebted to Rupert E. Hall of Chicago, for the first demonstration of a technic involving these principles. This was in Jefferson City, Missouri in the spring of 1915, and it was then that I began working on these principles. In 1918 M. M. House presented, at the meeting of the National Dental Association in Chicago a technic involving these principles. In the spring of the same year I presented to the Arhome without fear that they will not get proper service from their teeth.

Definite control of the necessary material is the most important factor in the technic. Some of the greatest difficulties in the past have been due to a lack of such control and in working with materials which do not possess the properties of enabling the operator to accomplish the desired results.

Modeling compound possesses properties that, when used alone, are very difficult to control to a degree of accuracy

that is required in a finished impression. A high degree of skill is required to manipulate it, and even with that accomplishment I doubt if it is ever manipulated accurately. This latter statement is made with due regard for the great skill of some modeling compound users. Modeling compound, however, does possess some properties which are desirable in the process of making a complete impression.

Plaster of Paris, when used alone, will reproduce accurately the surface it covers, and, if applied at the proper consistency, will not unduly compress or displace tissue. When used alone, however, it is almost impossible to control, as it is difficult to place the plaster in the desired area and make an impression that will definitely outline the denture. This difficulty, however, can be overcome by a technic in which both modeling compound and plaster are used. In the earlier methods of using a modeling compound tray, which was trimmed indiscriminately with a knife, according to the operator's judgment, and was followed by filling the tray with plaster and flowing it in the mouth, there was not sufficient accuracy, as there was no means of determining just how far the operator should seat the impression in order to cover the exact area desired. If the impression were seated entirely, the margins of the impression would, as a general rule, be too long, as the margins of the compound tray had been formed by guess. Even with the later technic of adjusting the margins of the modeling compound tray by means of muscle trimming, the impression, in the majority of cases, was not correct, as the operator could not determine just when sufficient muscle trimming had been done. It is obvious that if the modeling compound tray is accurately muscle trimmed, the tray can be seated with the soft plaster until it offers resistance, which will mean definite control in this step.



4 5

Figs. 4-5.—Fig. 4, muscle trimmed tray in position, showing no displacement or undue distention. Fig. 5, plaster impression in position with mouth open and tongue protruded.

The position of the oral structures that has the greatest tendency to dis-

lodge a lower denture is, from a buccal and labial aspect, when the mouth is opened rather wide, and from a lingual aspect when the tongue is protruded rather well out of the mouth to represent the legitimate movement of this organ in casting food from one side of the mouth to the other (Fig. 2). If a modeling compound tray that does not possess perfect adaptation, and consequently has no special molecular adhesion, will remain seated on the lower jaw when the mouth is open or the tongue protruded, or when both these conditions prevail, it is sufficient evidence that the margins of the tray are not too long. This is the test to which the modeling compound tray is submitted, and it must withstand this test before any attempt it made to use it in floating plaster over the jaw.

A B C D E

Fig. 6

Technic Briefly Stated

It has always been my intention to follow a technic covering the principles involved that does not require much time and gives such control as will not make repeated and continued efforts necessary in order to secure a satisfactory impression. The first step in this procedure is a snap impression (Fig. 1). To this little attention is given, other than to make certain that the impression covers more area in every direction than the operator hopes to cover with the finished denture. This means, of course, that the snap impression, which is taken in modeling compound with any ordinary lower tray, will, as a general rule, considerably displace and distend the structures. For this snap impression Kerr's, or some other similar compound which becomes plastic at a lower temperature than the S. S. White tray compound, is used. This snap impression is removed from the metal tray, and the excess, particularly in thickness, is cut away when the operator is ready for the muscle trimming process (Fig. 6 b). I call this procedure "muscle trimming" for the lack of a better term, altho it is not done for the purpose of definitely establishing muscle position in the margin of the modeling compound, because, if such were the case, this definite marginal adjustment would be obliterated by the application of the plaster that is to follow. The system of muscle trimming is not very, if any, different from that advocated by the Greene Brothers many years ago, and is used for the purpose of reducing the margins of the tray to a point where they are not too long. When this process of muscle trimming, which is done a section at a time, usually requiring from four to six sections with which to complete the buccal and lingual borders, has been finished (Fig. 6 c) the tray is ready for the test to determine if the muscle trimming has been properly done, or if the margins have been reduced to a length which is not too great. This first test is to place the tray in the mouth, hold it in position with the thumb and forefinger of each hand, have the patient open the mouth rather wide, remove the thumb and fore-

fingers from contact with the tray, and observe if the tray is lifted from its position. If the tray is lifted from its position, the buccal and labial margins are too long, and the process of muscle trimming must be repeated until the tray will remain in position. The second test is made with the tongue protruded. If,

A B

Fig. 7.—A, extension without undue displacement; B, ordinary lower denture worn by same patient.

when holding the tray as before stated, the tongue is protruded and the pressure is released from the tray, it is lifted from its position by lingual attachments, then in that case the lingual margins are too long, and the muscle trimming process in this region must be repeated until it will withstand the test without the tray being lifted from position. Having thus adjusted the margins of the tray, the remaining part of the procedure is simple. A mixture of plaster is made, rather thin and quick setting, accelerated with a saturated solution of potassium sulphate. The compound tray is filled with this thin mixture of plaster and carried into the mouth, when the plaster is shaken from the tray, which is followed by a slow, but complete seating of the tray without much pressure. The seating of the tray can be determined by the resistance that is offered. The mouth is then opened wide enough to produce some tension of the buccal and labial structures, and the tongue is protruded to a moderate degree (Fig. 5). It is permissible at this point, if necessary, to assist the cheeks to a position of rest under these conditions. The tray and plaster are held in position until the plaster has crystallized. On removing the impression from the mouth, it will be found that the layer of plaster is thin, but uniform, and, as a rule, the margins will be completely covered with plaster (Fig. 6 *d*. This impression will definitely outline the finished denture, and in 50 per cent of the cases this finished denture will not have to be altered (Fig. 6 *e*, Fig. 7.).

REPORT OF ROENTGENOGRAPHIC AND CLINICAL FINDINGS IN THE TEETH OF NINE HUNDRED PATIENTS

By MATTHEW F. EUSTERMAN, D.D.S., Rochester, Minnesota

THESE patients were referred to the dental department of the Mayo Clinic within a period of three months for the roentgenologic and clinical investigation of foci of infection or as a part of their routine examination.

Two thousand ninety-nine pulpless teeth were found in a series of 900 patients. Taking a normal mouth with thirty-two teeth as a basis, 7 per cent were pulpless, giving an approximate average of two pulpless teeth to each person. Twenty per cent of the teeth were negative to the Roentgen ray; 80 per cent revealed evidence of some lesion inclusive of minute rarefaction, granuloma, or cyst.

Two hundred forty-four normal or nearly normal occlusions, approximately 30 per cent, were found in 789 of the 900 patients whose occlusions were determinable. In patients who were equipped with dentures, the occlusion could not be considered. The gums of two hundred eighty patients, 31 per cent, were found to be apparently uninfected. The similarity between the percentage of normal occlusions and healthy gums verifies the fact that maloccluded teeth allow for ingress of pyorrheal infection.

The physical condition of the patients warranted the removal of 254 remaining roots, and 2,619 teeth (7 per cent of the total number,) because of devitalization, caries, or affection by pyorrhea to the degree that they were not amenable to treatment; forty-five residual areas of infection following the extraction of teeth required curettement.

Pyorrhea appears to predominate in its incipiency. Five per cent of the patients affected by pyorrhea presented mouths in which the infection had resulted in osseous destruction as revealed by the Roentgen ray, recession of the gums, and loose teeth. Eighty-two per cent showed evidence of suppurative gingivitis and occasionally loose teeth, and the remaining 13 per cent of a low-grade gingivitis.

Impacted teeth, approximately 60 per cent of which were lower third molars, were found in 13 per cent of of the patients. Impacted teeth were found more often in males than in females; they were found most often in association with lesions of the stomach, gall, bladder, appendix, kidneys, urinary bladder, with arthritis, and poor general health. (Table I). In a consideration of the findings it must be borne in mind that these patients were referred to the dental department for the investigation of foci of infection because of ill health or as a part of the routine examination.

The modern dentist, unlike the den-

TABLE I

ROENTGENOGRAPHIC AND CLINICAL FINDINGS IN 900 PATIENTS. SECTION ON DENTAL SURGERY

Females	441	
Males	459	
Average age of females, years	31	
Average age of males, years	36	
Tonsillectomies	186	
Bites:		
Normal	244	
Mutilated	253	
Over	100	
End-to-end	82	
Intraverted	61	
Protruding	49	
Indeterminate	111	
Teeth:		
Carious	131	patients
Prophylaxis indicated	150	patients
Pulpless	2099	
Negative	467	
Rarefied	1125	
Granulomatous	464	
Cystic	43	
Unerupted	112	
Negative	92	
Condemned	20	
Impacted	186	
Negative (19 patients)	34	
Positive (106 patients)	152	
Upper left third molars	21	
Upper right third molars	25	
Lower left third molars	42	
Lower right third molars	44	
Upper left cuspids	6	
Upper right cuspids	11	
Upper right second bicuspids	2	
Lower right first bicuspids	1	
Alveoli:		
Remaining areas of infection following extraction of teeth	45	
Remaining roots following extraction of teeth	254	
Gums:		
Normal	280	patients
Pyorrhea Grade 1	253	
Pyorrhea Grade 2	260	
Pyorrhea Grade 3	37	
Gingivitis	70	
Crowns:		
Shell	1231	teeth
Richmond	144	
Davis	25	
Open face	21	
Porcelain jacket	1	
Fillings:		
Inlay	801	
Amalgam	4008	
Synthetic	163	
Gold foil	?	

General diagnosis of patients with positive impacted teeth:	
Diseases of the stomach	16
Diseases of the bladder and kidney	13
Arthritis	11
Poor general condition	11
Headache	9
Diseases of the gall-bladder	8
Appendicitis	7
Diseases of the heart	6
Diseases of the skin	6
Myositis	6
Diseases of the ear	3
Neuritis	3
Constipation	2
Epilepsy	2
Colitis	1
Disease of the eye	1
Indeterminate	1

tist of the old school, does not have in mind the restoration of the masticating function primarily. Paramount in his mind is the patient's present and future physical condition. A marked increase in the hemoglobin may follow the eradication of infected teeth and suggest a favorable prognosis. Formerly, physicians rarely referred patients to a dentist with the idea that their health would thereby be benefited. Today the success of a physician's treatment in many chronic systemic affections is dependent, to a great extent, on the skill and judgment which the co-operating dentist exercises in interpreting dental lesions and their eradication. The requisites of a thoro dental diagnosis are: (1) knowledge of the patient's physical condition; (2) proper technic in making roentgenograms; (3) roentgenograms of the entire mouth and, if these seem inefficient, of the head; (4) correct interpretation of roentgenographic findings.

Certain systemic conditions require the removal of all pulpless teeth, while others necessitate the removal of those which show definite evidence of pathologic changes. Altho an increase in the erythrocytic infection may follow the removal of infected teeth, as in the secondary anemias, in the neurasthenic pa-

tient, his state of mind may remain depressed.

The psychoneurotic balance of a patient with exophthalmic goiter may be disturbed and the metabolic rate raised when he is informed that a number of teeth require removal. Dental surgical interference may be avoided in many such instances if the dental surgeon is equipped with the physical diagnosis made by the physicians with whom he co-operates.

In making roentgenograms of the teeth, the angle and time of exposure and the position of the film are the chief requisites for clear and readable results. A comprehensive study of the variations of the human skull greatly aids the roentgenologist in the determination of the proper angle and time of exposure. Chart 1 shows the standardized time of exposure used at the Mayo Clinic on a ten milliampere tube machine.

Recently I[1] reported the roentgenographic findings in 290 patients with dentures. One hundred twenty-nine remaining roots, evidence of nine residual areas of infection, and thirteen unerupted teeth covered by dentures that had been in place for an average of eight years were found. Thirty-five per cent of these mouths harbored infections. Full-mouth roentgenograms should be

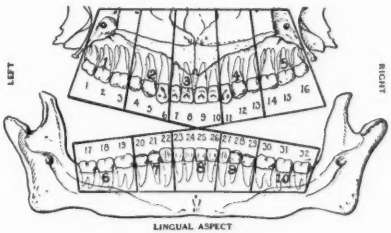


Chart 1.—AVERAGE TIME OF EXPOSURE

Upper Jaw

Extra Light	Light	Medium	Heavy	Extra Heavy
1=6 sec.	1=7 sec.	1=8 sec.	1=9 sec.	1=10 sec.
2=2 sec.	2=3 sec.	2=4 sec.	2=5 sec.	2= 6 sec.
3=3 sec.	3=4 sec.	3=5 sec.	3=6 sec.	3= 7 sec.
4=2 sec.	4=3 sec.	4=4 sec.	4=5 sec.	4= 6 sec.
5=6 sec.	5=7 sec.	5=8 sec.	5=9 sec.	5=10 sec.

Lower Jaw

6=2 sec.	6=3 sec.	6=4 sec.	6=5 sec.	6=6 sec.
7=1 sec.	7=2 sec.	7=3 sec.	7=4 sec.	7=5 sec.
8=1 sec.	8=2 sec.	8=3 sec.	8=4 sec.	8=5 sec.
9=1 sec.	9=2 sec.	9=3 sec.	9=4 sec.	9=5 sec.
10=2 sec.	10=3 sec.	10=4 sec.	10=5 sec.	10=6 sec.

[1]"Roentgenographic Findings in 290 Partially Edentulous or Edentulous Mouths," *Dental Cosmos* Vol. LXIII (1921).

taken of practically every patient whether edentulous or not.

A thoro knowledge of interpretation of roentgenographic findings can be obtained by graduate study, wherein sufficient time is allowed for the study of this phase of dentistry, witnessing many alveolotomies and wherein roentgenographic findings can be verified by visualizing the condition present. The old method of removing teeth does not allow for this verification.

Final conclusions with regard to the dentist's findings from a therapeutic standpoint should be left to the physician's decision. In some instances a bacteriologist might be consulted in order to determine whether treatment should be conservative or radical.

The virulence of the infecting organism and the degree of specificity which it has developed can be determined by removing a pulpless tooth and passing cultures from it thru animals. The type of organism and its selective affinity often determine the degree of involvement teeth have in ill health. The dentist should include in his report the teeth he believes should be removed for local reasons, and those which should be removed if the systemic condition warrants a more radical procedure. An estimate of the relation of the condition of the teeth to the general condition of the patient should be made by the dentist.

It is common experience that often removal of infected teeth does not appreciably change the patient's general condition, altho all other causative factors apparently have been eliminated. Many persons are, therefore, doubtful of the causal relationship of dental and systemic affections. A consideration of four factors may answer such doubts.

1. General disease conditions are often not amenable to treatment if they have become chronic to the degree that the system has become permanently damaged. Arthritis with hypertrophic changes produced by infected teeth, necessitating various kinds of treatment, is a typical condition.

2. The technic employed in the removal of teeth with infection at their roots often does not allow for the elimination of the pathologic condition. When it is impossible to remove a tooth with the surrounding infected area by simple measures, more extensive surgical procedure is indicated.

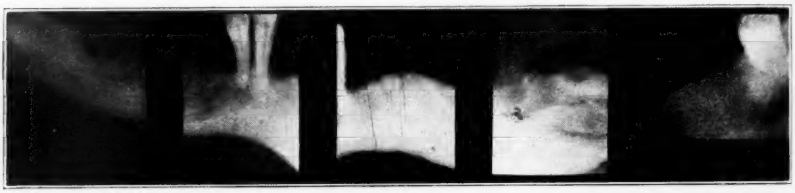


Fig. 1

3. Too little importance is attached to pyorrhea. Many dentists remove chronically infected teeth and allow the pyorrheal teeth to go unattended.

4. Foci of infection other than oral in many instances are not revealed. Low-grade sinus infections without symptoms and small tonsils which may harbor highly infective organisms often are overlooked.

The removal of tonsils is advised by many physicians in every frank case of

arthritis[2]. Physicians are justified in advising the removal of all pulpless teeth in such conditions. Ocular disturbances attributable to focal infection, nephritis, cystitis, gastric ulcer, and endocarditis likewise demand the removal of most pulpless teeth, the physical condition of patients permitting, in order that favorable therapeutic results may be obtained. Other conditions may be added as research continues to reveal diseases in which focal infection plays an important part. The condition of the patient and the stage of the disease indicate the opportune time to eliminate such infections. Altho the specificity of the infective organisms apparently changes when teeth with gross lesions are removed, a lowered resistance at some future time will render the remaining pulpless teeth as infective as those removed. Therefore in any chronic systemic condition attributable to infected teeth, all pulpless teeth should be suspected as causative factors as seriously as teeth with definite periapical lesions.

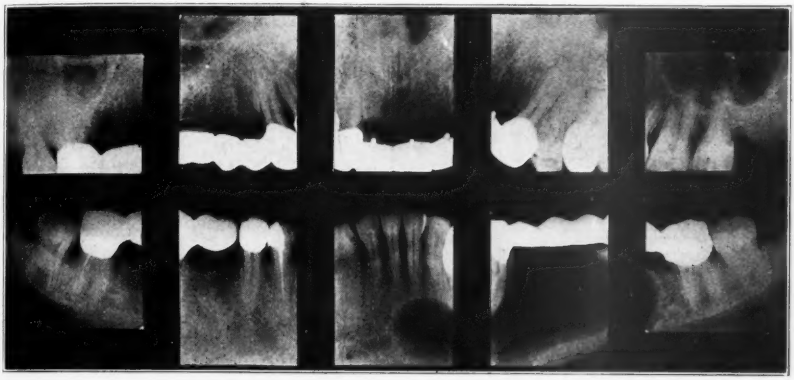


Fig. 2

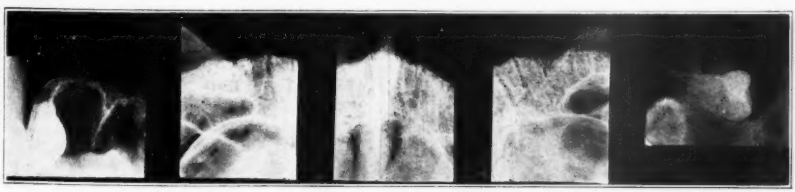


Fig. 3

[2]H. I. Lillie and H. R. Lyons "Tonsillectomy in Myositis and Arthritis. Results in 200 Consecutive Cases," *Jour. Amer. Med. Assoc.*, (1919), LXII, 1214-16.

Illustrative Full Mouth Roentgenograms

Case 1.—The patient registered at the Mayo Clinic without oral complaint except that she had "a sore spot on her gums," the results, she believed, of an ill-fitting denture. A full-mouth roentgeno-

gram, made as part of the routine physical examination, revealed a diffuse osteomyelitis involving the entire mandible (Fig. 1). Roentgenograms were also made of the head in this case.

Case 2.—A roentgenogram of the mouth revealed a cystic area extending from the lower central incisor to the second molar (Fig. 2). The patient had not had symptoms.

Case 3.—The patient had an edentulous upper jaw. A denture had been in place for ten years. Roentgenographic findings revealed impacted upper left and right third molars, and systemic conditions warranted their removal (Fig. 3).

Summary

1. Roentgenographic findings in this series of cases demonstrate that full-mouth roentgenograms are essential to a thoro physical diagnosis.

2. The findings demonstrate the importance of good occlusion in treating pyorrheal mouths. That normal gums and normal occlusions are associated, is conspicuously evident.

3. Chemical devitalization due to synthetic restorations in young patients, in a number of cases demonstrates the infeasibility of this type of restoration in an undeveloped tooth, without a proper cavity lining.

4. Ninety per cent of the amalgam restorations showed bad margins altho the number of cases in which caries surrounded these fillings would in no way approach such a percentage.

5. Ninety-three per cent of patients with cholecystitis had suppurative gingivitis. Bacteriologic findings do not verify clinical findings.

6. An average of approximately two pulpless teeth to each person was found; this accounts for the infrequency with which teeth are found to be associated with general disorders.

7. The tentative physical diagnosis accompanying these as referred to the dental department do not allow me to verify the statement that they are, in the main, associated with any general disorders.

8. The large percentage of pulpless teeth giving evidence of pathological processes discourages promiscuous devitalization of teeth by present methods.

Reminiscences of Forty-five Years in Dentistry

By C. N. JOHNSON, M.A., L.D.S., D.D.S., M.D.S., F.A.C.D., Chicago, Illinois

III

THE first textbook on dentistry that I remember reading was Taft's *Operative Dentistry,* and as I pored over its pages, and noted some of the complicated gold restorations advocated therein, it seemed an almost impossible task to ever master the technic of anything so wonderful. The world of that kind of dentistry seemed so far removed from the utmost of what I could ever hope to achieve that I never dreamed of a day when the making of those very operations was to become a regular routine of practice. That I should some day be writing textbooks myself never entered the domain in my wildest imagination, and in fact all down the line from my earliest student days till now the duties, responsibilities, and favors that have come to me have invariably traveled far in advance of my ambitions or expectations. This is equivalent to saying that I owe everything that has been mine in the way of the professional preferment to the encouragement, magnanimity, and unceasing generosity of the members of my profession. Mine is, therefore, not a case of dreaming dreams that came true, because, assuredly, I never had a dream of the intense professional activities which the future had in store for me.

To use gold foil in my first efforts to make contour operations in extracted teeth would have been too expensive for me, and so I experimented with tin foil. I of course had many failures and when I finally did succeed in getting a large cavity in a molar filled with tin foil, the difficulties were so great, and the result so far from perfect—the filling did not look a bit like Dr. Taft's illustration—that it left me without much enthusiasm or confidence so far as foil fillings were concerned. There were two things that I did not realize: the difference in cohesive properties between gold foil and tin foil, and the fact that it is so much more difficult to fill a tooth in the hand than in the mouth.

When I first attempted to fill teeth for patients I of course used amalgam, cement or gutta-percha. Amalgam was the chief reliance, and with it I made my first filling in a tooth in the mouth, using a hand drill or bur as already described. It was in a lower molar, and I had the satisfaction of seeing this filling, still doing good service, during the summer of 1921. This was surely sufficiently permanent, but curiously enough I have had the perversity to be prejudiced against amalgam during most of my professional life. The moment I gained a mastery over the manipulation of gold foil that material claimed my allegiance unreservedly, and some of the most satisfying operations I have ever performed have been made with this material. Even when inlays were first introduced I found it difficult to acknowledge their virtues, and I fear I took up this work with altogether too great a mental reservation. I make this acknowledgment in all humility because of the fact that inlays have proved such a real benefaction, both to operator and patient, that I do not care to contemplate

our present plight if we were suddenly deprived of their use.

And speaking of filling materials, I am impressed with the fact that we have need of every kind of filling material in our possession today—some for one kind of service, and some for another. It is natural that operators form a preference for certain materials because of the greater facility with which they manipulate one material than another, and yet the broadminded man will not confine himself to one or two when there are are indications under certain conditions for every one of them.

It was shortly after I became a student that the full tide of attack against gold as a filling material took place under the name of the "new departure." Never was a campaign launched with greater energy or more adroitness. It was championed chiefly by three men of no mean ability, Drs. Flagg, of Philadelphia, Chase, of St. Louis, and Palmer of Syracuse. I think it was Dr. Flagg who coined the phrase: "In proportion as teeth need saving gold is the worst material to use for filling." The aggregate amount of harm caused by this propaganda can never be estimated. It was caught up by men who lacked the ability or energy to use gold, and was made to justify very much indifferent work with the plastics. It was surely not constructive dentistry, nor was the argument based on sound principles; because the fact stands today, as it did even in those days, that without the wonderful service performed by gold in the saving of teeth the status of dentistry would assuredly have been relegated to a lower plane.

I acknowledge with the greatest frankness that one should never close one's eyes to the virtues of the plastic, which in their way have done much for the preservation of the human teeth, and have filled a place in dentistry that would never have been met by gold alone; and yet with all of this the fact remains that in a study of the intrinsic merits of the various materials as gauged by their physical properties and their service under all conditions in the mouth, gold stands paramount. Now that we may employ it in the form of inlays, as well as foil, its range of usefulness has greatly widened, from the fact that it is possible to use it acceptably in many large restorations where foil would be prohibited on account of the nervous tension on the patient.

I shall never forget the wordy war which was waged over the "new departure" creed in the late seventies and early eighties, and while I was at that time too immature in the profession to take an active part in the controversy, yet I had seen gold operations in the mouth which compelled me to oppose the "new departure" idea, even as a student, and needless to say I have gone on opposing it ever since.

And this was not the only idea advanced by J. Foster Flagg, of endeared memory, with which I found myself in sharp variance. Years later I had the misfortune on one occasion to unconsciously tread severely on his toes by calling in question the virtues of cotton as a root filling. I had not known that it was, at that time, his pet hobby, but I very much fear that it would have made no difference in my attitude even if I had known. In any event he got to the floor, after my paper had been read, and riddled me with invective and ridicule, of which he was a past master, when he was crossed in an argument. He claimed that cotton was a much misunderstood material, and cited as evidence of its virtue as a root-filling that a bale of cotton thrown in the ocean would absorb moisture only to the depth of half an inch after several weeks of floating. My rejoinder was that any material which absorbed moisture to the depth of half an inch did not appeal to me as a root filling—it was too far for the length of most canals. We shook hands after the meeting, and that was the last time I saw Dr. Flagg. How often have I wished

since that day that I might have had the privilege of sitting by his side and chatting with him over the problems of our profession! He was a man of much force, and while I could not agree with him in many of his ideas, yet I admired his great ability and his unceasing energy. We do not often enough pause to pick out the good points of these old pioneers, who hewed away in an unbeaten path, and made our road much the easier to travel. Before I conclude the present series of papers I hope to touch on the leading traits of many of the prominent men of my day, and yet I have little idea that I shall deal with any who had more of the picturesque in his make-up than had J. Foster Flagg.

My reference to the textbook of Dr. Taft reminds me of the esteem in which I held Jonathan Taft even before I met him. He stands out in my memory as one of the sturdiest of that noble band of advocates for the higher ideals of professional life, who in the latter part of the past century did so much to mold the destinies of dentistry. He was a clear, deliberate and convincing speaker, and he never rose in any audience of dentists without commanding immediate and sustained attention. His well-known advocacy of gold foil for filling teeth to the exclusion of amalgam made him a marked figure in the days when the controversy was at its height as to the relative advantages and disadvantages of the different materials. While we cannot agree with him that amalgam should be excluded from our list of filling materials, yet we must respect his conviction that nothing but the very best should ever go in a human tooth; and in erring at all he erred in the direction of the highest class of service and of the purest ideals.

As we look back over the careers of men, we judge them not so much by the criterion as to whether or not they were always right, as we do by the ultimate effect of their influence upon dental thought and practice, and in this view of the case the name of Jonothan Taft will ever stand high in the annals of dentistry in the Middle West.

Another man of distinguished ability as a gold operator was the late H. J. McKellops, of St. Louis, Missouri. He took the same position as Dr. Taft, asserting that he would never use amalgam. I sat in a meeting once and heard a speaker question Dr. McKellops' statement that he never used amalgam. Said he: "I happen to know that Dr. McKellops *does* use amalgam, because I saw one of his amalgam fillings in a lower molar a short time ago. The patient was positive about it being his filling. It was as beautiful an amalgam filling as I ever saw, contoured to perfection and beautifully polished, and if I could do as good amalgam work as that, I would not disclaim it." I jumped to my feet instantly and said: "Mr. President, I cannot sit in this audience and hear the word of Dr. McKellops questioned. When he says he does not use amalgam, *he does not.* My friend here in describing that beautiful filling with its contour and finish was merely describing one of Dr. McKellops' platinum and gold fillings—a material over which he is very enthusiastic." My friend came to me after the session, and said: "Johnson, why did you give me away like that before the whole society?" I answered: "Because, before the whole society you had cast a reflection upon the integrity of a man when he was not present, and I did not propose to permit that reflection to stand, particularly when the man was H. J. McKellops." Dr. McKellops heard about the incident later, and I never saw him at a meeting of the National Dental Association that he did not gather around him a coterie of friends and beckon me to him and say: "Johnson, tell them that story."

Here was a stalwart of the stalwarts among the great operators of the day, and dentistry would never have been quite what it was as a high class art if it had not been for H. J. McKellops.

(*To be continued*)

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Editor and General Manager,
OTTO U. KING, D.D.S., F.A.C.D., 127 N. Dearborn St., Chicago, Illinois.

Associate Editors,
THOMAS P. HINMAN, D.D.S., F.A.C.D., Atlanta, Ga.
HARVEY J. BURKHART, D.D.S., LL.D., F.A.C.D., Rochester, N. Y.
THOMAS B. HARTZELL, D.M.D., M.D., F.A.C.D., Minneapolis, Minn.

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IN CHANGES of ADDRESS both the old and new address must be given.

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VOL. 9 MARCH, 1922 No. 3

Editorial Department

GREATER BREADTH OF VISION

The crying need among dentists is a larger concept of professional life thru the medium of a cultural extension of their activities into a wider range of interests than the mere routine of daily practice. Nothing can be more pathetic than a professional man drifting down the western slope of life with his vision narrowed into one little worn gulley cut in the hillside thru years and years of concentration on one idea. As a man reaches the zenith and starts over the brow he should be able

to take in the whole glorious landscape of life, and revel in the rays which slant from a myriad brilliant hues. A single light may wane and grow pale—it may even flicker out, and leave the wearied traveler in the dismal dark; but with the heavens filled with radiant suns, and moons, and sparkling stars, he may go serenely on with the halo of a hundred beams to light his pathway to the end of the winding road.

It matters not so much what interests enter into a man's life provided they are elevating and constructive. It may be music, it may be art, it may be horticulture, it may be mechanics or it may be literature. It may be none of these, but something else that is so absorbing that it possesses the man, and actually claims his very soul at times. This makes of the dental practitioner not only a better man but a better dentist.

To concentrate on one thing to the exclusion of every other interest in life is to run the risk of becoming narrow and stale. And what is narrower than a narrow professional man? Not one thing in all human experience. For a dentist to pin his interests down solely to that small—if significant—thing called a cavity in a tooth, is to limit his horizon and dwarf his vision. In order to be able to see all sides of any situation one must look over it and beyond it—to keep looking straight at it is to get only one point of view.

And a man need not be brilliant to cultivate other interests than those connected with his calling. It is not necessary that he be an Edison or a Marconi to be absorbed in the miracle of the wireless. He does not have to own a farm in order to grow a garden and get happiness out of it. He does not need to sway a continent with his wisdom in order that he may add his mite to the sum total of human intelligence. The day of small things as well as of big things is here—nothing must be despised. If a dentist contributes an idea to the mental wealth of the world he has achieved greatness—greatness possibly not of the type to be heralded from the house tops, but greatness in the larger and better sense, the sense of realizing that he is part and parcel of the wondrous throbbing heart of humanity.

And our profession has not been altogether devoid of distinction in this particular. Instances might be multiplied where dentists have performed signal service for the welfare of mankind. Take the one example of the boon of anesthesia—given to the world by a dentist. If we had no other brief for our case, this one achievement is sufficient to bring distinction and glory to our calling.

The late Norman W. Kingsley was a sculptor of the highest order—his bust of Christ having been accounted one of the best that

was ever made. Other men have excelled in the arts and there are doubtless many "mute inglorious Miltons" among the dentists scattered far and wide that the world has never heralded.

Another concrete example is the late lovable Garrett Newkirk of California. Before his death he had made the world his debtor in no small degree by the books he had published, and now, months after he has passed to the Great Beyond, his latest and best book, *Lincoln Lessons for Today,* has just been issued. It was upon this book that he had lavished the greatest of his literary affections. He had worked on it for years, and it was a finished product when he laid down his loving pen for aye. Every dentist—every man—every woman and child, who loves Lincoln and America should read this book.

And thus we might enlarge. The breadth of vision that comes to a professional man from cultivating interests outside of his calling is to be in the future, as it has been in the past, no mean factor, not only in adding zest and pleasure to the experiences of the man himself, but in broadening the entire profession and lending additional distinction to our calling.

THE STORAGE OF VITAMINS IN THE BODY

Two facts of pre-eminent importance have been established by investigations in nutrition. One is that those peculiar and physiologically potent properties of foods designated as vitamins are essential to the well-being of the human organism. The other equally significant, tho perhaps less thoroly appreciated, fact is that apparently these vitamins are not synthesized or manufactured in the human tissues, but the body depends on an extraneous supply which in ultimate analysis seems to be derived from plant sources. Recently some attention was devoted in the *Journal* to the evidence for the interrelations between the vitamin potency of feeds and the antiscorbutic property of the milk secreted by animals which eat them. It seems at present to be well established that the mammary secretion reflects, so to speak, the richness of the diet of the lactating animal in antiscorbutic vitamin.

Something of a comparable sort seems now to be clearly demonstrated for the distribution of the fat-soluble vitamin A. It has been recognized, since the pioneer researches of McCollum and Davis and of Osborne and Mendel in this field in 1913, that the otherwise wholesome pig fat lard is ordinarily exceedingly poor in vitamin A in comparison with the fat of cow's milk (butter fat), egg fat, or even the abdominal

fat of cattle which enters into so-called oleo oils. Now then, however, there have been reports on instances in which the pig fat seemed to respond better to the tests for the vitamin A. The recent discussions regarding the possible identity of the latter with the antirachitic potency of certain foods like cod liver oil, which is singularly rich in this vitamin, have awakened much interest in the entire subject.

Recent investigations of a group of English workers seem destined to bring greater clarity and explain the seeming singular deficiency which lard has been found to exhibit so commonly. It appears from their animal tests that the pig is able to store up supplies of vitamin A in the body fat when fed on a diet containing ample supplies of that factor, as, for example, when grass-fed; but when the diet of the pig is deficient in vitamin A, no appreciable amount of that dietary factor can be detected in the body fat.

It happens, presumably, that the diet usually given to fattening pigs in this country is seldom rich in vitamin A, so that the average sample of pig fat contains little or none of that substance. Furthermore, another factor tending toward the destruction of vitamin A which actually may be present in pig fat is apparently effective in much of the commercial manufacture of lard. Various investigators, notably Hopkins, and Drummond and Coward, have indicated that altho the vitamin A present in butter, for example, is not highly sensitive to heat in the absence of air, destruction takes place readily on heating in the presence of air. It is probable, therefore, that the loss is due to changes of an oxidative nature. The process of commercial lard manufacture undoubtedly causes the destruction of much of the vitamin present in the original pig fat, probably owing to the exposure of the fat to oxygen at high temperature. For us the lessons of importance are not so much to be sought in the lower or higher content of vitamin A in any particular fat like lard or its analogues, but rather in the physiologic lesson that the character of the diet can undoubtedly influence the store of all types of known vitamins in the body. This conclusion may be of pronounced significance for the nursing mother in determining a beneficial or baneful effect on her milk thru her diet.—*Jour. Amer. Med. Assoc.*, 1921.

DELINQUENT MEMBERS DROPPED FROM MAILING LIST

All dues, which include the annual subscription to *The Journal of the National Dental Association*, are due January 1 of each year. The

April *Journal* will not be mailed to any delinquent members. The ruling of the post office authorities is adamant on this proposition. Therefore any dentist who has not already paid his state society dues for 1922 should do so immediately. The state society officers are co-operating with the national organization and will immediately, on receipt of the state dues, mail the national dues to the national office.

It will be impossible for us to furnish back copies as we are printing only enough to supply our bona fide mailing list. An immediate compliance with this notice will save the delinquent member a great deal of confusion and misunderstanding. A delinquent member is one who does not have his 1922 membership card.

CIRCULATION OF THE JOURNAL BY STATES

Alabama	289	Navy	20
Alaska	10	Nebraska	519
Arizona	52	New Hampshire	76
Arkansas	224	New Jersey	885
Army	117	New Mexico	62
Southern California	839	New York	2661
California	1103	North Carolina	317
Colorado	412	North Dakota	188
Connecticut	512	Ohio	1781
Delaware	38	Oklahoma	394
District of Columbia	229	Oregon	358
Florida	177	Pennsylvania	2161
Georgia	361	Philippine Islands	4
Hawaiian Islands	34	Porto Rico	1
Idaho	65	Rhode Island	154
Illinois	3330	South Carolina	77
Indiana	1400	South Dakota	233
Iowa	1158	Tennessee	458
Kansas	608	Texas	792
Kentucky	454	Utah	178
Louisiana	233	Vermont	105
Maine	207	Virginia	275
Maryland	261	Washington	525
Massachusetts	1522	West Virginia	287
Michigan	1078	Wisconsin	1095
Minnesota	1369	Wyoming	75
Mississippi	247	Canada	175
Missouri	1035	Unclassified Subscribers	2094
Montana	133		
National Capital	53		33500

STATE OF ILLINOIS } SS.
COUNTY OF COOK }

Subscribed and sworn to before me this 30th day of January A. D. 1922.

(Signed) MARTHA H. HORNER,
Notary Public

(Notarial Seal)

I, OTTO U. KING, Business Manager and Editor of THE JOURNAL of the National Dental Association, certify that the above mentioned figures are correct.

(Signed) OTTO U. KING.

THE JOURNAL MEETS WITH APPRECIATION IN AUSTRALIA

Dear Dr. King:

I have been instructed by the President and the Committee of the Odontological Society of Victoria to send our greetings and express our appreciation for your dental journal.

We notice that you are setting a high and exclusive standard, which should certainly raise the standard of all contemporary publications.

With best wishes for your magazine and for the future of dental science in America,

Yours faithfully,

ERIC W. WILLS, B. D. SC.

Melbourne, Australia.

ONE OF MANY TRIBUTES

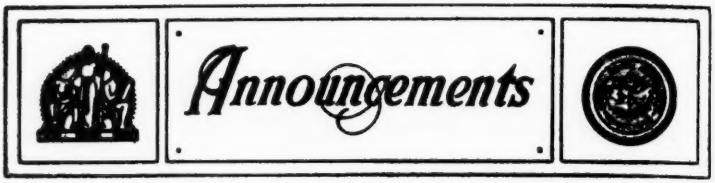
"It is a real pleasure to receive the *Journal* each month. I note the improvement of the *Journal* in dress, cover display, and the quality of the advertisements and index for same; in fact, it has outdistanced all others."

LET'S GO—ON TO LOS ANGELES!

The 1922 meeting of the National Dental Association will be held in Los Angeles, at the Ambassador Hotel, July 17, 18, 19, 20, 21. The frontispiece in this issue of the *Journal* shows the beauty and grandeur of the hotel; it also calls attention to the unusual facilities afforded for holding another of our great meetings, including all section programs, under one roof. The program is practically complete, and will be published in the May *Journal.*

The May issue will be known as the *Los Angeles Number.* It will contain the complete program, including titles of all the papers with the names of the essayists and the discussers, the clinics and the clinicians, announcements of the special dental trains, of railroad and hotel rates, of the meetings of other societies and fraternities, and of the big dental health exhibit, together with a list of all exhibitors.

The Los Angeles meeting promises to establish a new standard in the history of dental conventions.



CALENDAR OF MEETINGS

NATIONAL SOCIETIES

National Dental Association, July 17-21, 1922, Ambassador Hotel, Los Angeles, Cal. Otto U. King, Secretary, 127 N. Dearborn St., Chicago, Ill.

National Society of Denture Prosthetists, July 3-15, Dental Department, University of Southern California, Los Angeles, Cal. E. B. Owen, Secretary, 335 Frisco Bldg., St. Louis, Mo.

National Association of Dental Examiners, July 17 and 18, Ambassador Hotel, Los Angeles, Cal.

National Association of Dental Faculties, July 13, 14, 15, Hotel Clark, Los Angeles, Cal.

National Dental Sorority, July 17, Ambassador Hotel, Los Angeles, Cal.

American Dental Library and Museum Association, July 17, Ambassador Hotel, Los Angeles, Cal.

American Society of Oral Surgeons and Exodontists, July 11-14, Hotel Alexandria, Los Angeles, Cal.

Association of Military Dental Surgeons, July 18, Los Angeles, Cal.

American Academy of Periodontology, July 10, 11, 1922, Drake Hotel, Chicago, Ill. J. Herbert Wood, Secretary, Cleveland, Ohio.

American Society of Orthodonists, April 24, 25, 26, 1922, Edgewater Beach Hotel, Chicago, Ill. Ralph Waldron, Secretary.

American Dental Society of Europe, July 28-31, London, England. William A. Spring, President, 8 W. 40th St., New York, N. Y. F. W. Fleming, Secretary, 13 Queen Anne St., London.

STATE SOCIETIES

March

Arkansas at Little Rock (20, 21, 22).
South Dakota, at Sioux Falls.
Texas, at Houston (13, 14).
Vermont, at Burlington (15, 16, 17).

April

Alabama, at Birmingham (11, 12, 13).
Connecticut, at New Haven (20, 21, 22).
Kentucky, at Louisville (10, 11, 12).
Michigan, at Detroit (4, 5, 6).
Mississippi, at Meridian (18, 19, 20).
Pennsylvania, at Pittsburgh (11, 12, 13).
Tri-State—Oklahoma, Kansas and Missouri, at Kansas City, Missouri (10-15).
West Virginia, at Fairmont (10, 11, 12).

May

Illinois, at Springfield (9, 10, 11).
Indiana, at Indianapolis (15, 16, 17, 18).
Iowa, at Des Moines (2, 3, 4).
Louisiana, at Shreveport, (8, 9, 10).
Maryland, at Baltimore (2, 3, 4).
Massachusetts, Worcester (2, 3, 4).
Nebraska, at Lincoln.
New Jersey, at Trenton (3, 4, 5).
New York, at Rochester, (11 12, 13).
North Dakota, at Fargo.
South Carolina, at Georgetown.
Tennessee, at Memphis (8, 9, 10, 11).

June

California (Southern), at Los Angeles.
Colorado, at Colorado Springs (15, 16, 17).
Georgia, at Augusta (14, 15, 16).
New Hampshire, at The Wiers (26, 27, 28).
New Mexico, at Albuquerque (26, 27, 28).
North Carolina, at Wrightsville Beach (12, 13, 14).
Utah, at Salt Lake City (19-24).
Wyoming, at Sheridan (20, 21, 22).

July

Washington, at Seattle.
Wisconsin, at Milwaukee (11, 12, 13).

September

Delaware, at Wilmington (14).

MEETINGS OF STATE BOARDS OF DENTAL EXAMINERS

Idaho, at Boise. Bureau of License, January 10, and July 11, 1922. Paul Davis, Director, Bureau of License, Boise.

Indiana, at Indianapolis, June 12-17. H. C.

McKittrick. Secretary, 1006 I. O. O. F. Building, Indianapolis.

Kansas, June 19-23, at Wichita, G. F. Ambrose, Secretary, El Dorado.

Massachusetts, March 21-24. J. N. Carriere, Secretary, 146 State House, Boston.

Mississippi, Senate Chamber, State Capitol Building, Jackson, June 20. B. J. Marshall, Secretary, Marks.

Oklahoma, at Oklahoma City, June 26. L. M. Doss, Secretary, American National Bank Building, Oklahoma City.

Texas, at Dallas, June 19-22. R. L. Rogers Secretary, Amarillo.

Wisconsin, June 19-24. J. L. Blish, Secretary, Fond du Lac.

STUDY CLUBS AND OTHER SOCIETIES

Alumni Association of the Baltimore College of Dental Surgery, May 30 to June 1, 1922, Emerson Hotel, Baltimore, Maryland. Secretary Norval H. McDonald, 904 N. Charles St., Baltimore, Maryland.

Alumni Society of the Dewey School of Orthodontia, April 27, 28, Edgewater Beach Hotel, Chicago, Illinois. Secretary, George F. Burke, 741-43 David Whitney Bldg., Detroit, Mich.

Dental Hygienist Association of the State of New York, May 12 and 13, Rochester Dental Dispensary.

Northern Ohio Dental Association, June 5, 6, 7, Hotel Statler, Cleveland, Secretary, George B. Smith, Fremont, Ohio.

Philadelphia Dental College, April 19, Secretary, William H. Magann, 1222 N. Eighteenth St., Philadelphia.

Southern Society of Orthodontists, March 14 and 15, Piedmont Hotel, Atlanta, Georgia. Secretary, O. A. Oliver, 306 Lambuth Bldg., Nashville, Tenn.

THE NEW JERSEY STATE DENTAL SOCIETY

The fifty-second annual meeting of the New Jersey State Dental Society will be held May 3, 4, 5, 1922, at the Stacy-Trent Hotel, Trenton, New Jersey. The essays, clinics, and exhibits, arranged for, assure an inspirational gathering. A cordial invitation is extended to everyone interested in ethical dentistry. The support of our exhibitors is appreciated and they can be depended upon to demonstrate the best that is made.

For Convention details address Dr. R. S. Hopkins, director, 913 Broad Street, Newark, New Jersey. For general information,

F. K. HEAZELTON, *Secretary*,
223 E. Hanover St., Trenton, N. J.

CONNECTICUT STATE DENTAL ASSOCIATION

The Connecticut State Dental Association will hold its fifty-eighth annual meeting, April 20, 21, 22 at the Hotel Taft, New Haven. An interesting program is being arranged and all ethical members of the profession are invited to attend.

CLESSON F. GIBBS, *Secretary*,
886 Main St., Bridgeport, Conn.

ARKANSAS STATE DENTAL ASSOCIATION

The next meeting of the Arkansas State Dental Association, a great get-to-gether meeting, will take place at Little Rock, on March 20, 21, and 22.

G. C. JERNIGAN, *Manager*,
Rector, Ark.

THE DENTAL SOCIETY OF THE STATE OF NEW YORK

The Dental Society of the State of New York presents the following tentative program for the fifty-fourth annual meeting to be held at Rochester, New York, May 11, 12, and 13, 1922:

The essayists are: Herman Prinz, Philadelphia, Pa.; W. A. Price, Cleveland, Ohio; Hart J. Goslee, Chicago, Ill., "Fixed Bridge Work"; G. Walter Dittmar, Chicago, Ill., "Partial Denture Construction Clasp Attachments."

Report of Scientific Research Committee, W. R. Montgomery, Chairman, Buffalo, N. Y.; Report of Practice Committee, J. O. McCall, Chairman, Buffalo, N. Y. The Fellowship Committee has by unanimous vote awarded the William Jarvie Fellowship Medal to Herman Prinz, of Philadelphia.

The society extends a cordial invitation to all ethical dentists.

A. P. BURKHART, *Secretary*,
89 Genesee St., Auburn, N. Y.

MISSISSIPPI STATE BOARD OF DENTAL EXAMINERS

The Mississippi Board of Dental Examiners will hold its next meeting for the examination of applicants for license June 20, in the Senate Chamber, State Capitol Building, Jackson, Miss. Application and fees should be filed with the Secretary at least ten days before the examination. For full information, application blanks, etc., address

B. J. MARSHALL, *Secretary*,
5-6-7 Turner-Cox Bldg., Marks, Miss.

NORTHERN OHIO DENTAL ASSOCIATION

The sixty-fifth annual session of the Northern Ohio Dental Association will be held at Hotel Statler, Cleveland, Ohio, June 5, 6, and 7, with postgraduate course following.

GEORGE B. SMITH, *Secretary,*
Fremont, Ohio.

KANSAS STATE DENTAL BOARD

The Kansas State Board of Dental Examiners will hold its next meeting in Wichita, Kansas, June 19-23, to candidates for license to practice in Kansas.

For application blank and any other information, address

G. F. AMBROSE, *Secretary,*
El Dorado, Kan.

INDIANA STATE BOARD OF DENTAL EXAMINERS

The next meeting of the Indiana State Board of Dental Examiners will be held in Indianapolis from June 12 to 17.

For further information address

H. C. MCKITTRICK, *Secretary,*
1006 I. O. O. F., Bldg., Indianapolis, Ind.

AMERICAN DENTAL SOCIETY OF EUROPE

The thirty-ninth meeting of the American Dental Society of Europe will be held in London, July 28-31, 1922. American members of the profession all over the world are cordially invited.

WILLIAM A. SPRING, *President,*
8 W. 40th St., New York, N. Y.
F. W. FLEMING, *Secretary,*
13 Queen Anne St., London, England.

AMERICAN INSTITUTE OF DENTAL TEACHERS

The twenty-ninth annual meeting of the American Institute of Dental Teachers was held at Montreal, Quebec, January 23, 24, and 25. The following officers were elected to serve for the ensuing year: president, A. H. Hipple, Omaha, Neb.; vice-president, A. E. Webster, Toronto, Ont.; secretary-treasurer, Abram Hoffman, Buffalo N. Y. (re-elected); members of the Executive Board, E. D. Cooldige, Chicago, Ill.; Herbert L. Wheeler, New York City; R. H. Volland, Iowa City, Iowa.

The next meeting will be held at Omaha, Nebraska, January 22, 23, and 24, 1925.

ABRAM HOFFMAN, *Secretary-Treasurer,*
381 Lindwood Ave., Buffalo, N. Y.

THE NATIONAL ALUMNI ASSOCIATION OF THE BALTIMORE COLLEGE OF DENTAL SURGERY

Plans are progressing for the reunion to be held in Baltimore May 30, 31 and June 1. Arrangements have been made for the following speakers: Harvey J. Burkhart, director of the George Eastman Dispensary, Rochester, N. Y.; Paul R. Stillman and James Kendall Burgess, of New York City, and B. L. Brun and B. Holly Smith of Baltimore.

A letter has just been sent out to all the known living graduates in the country and if by any chance any one has been omitted from our mailing list, please communicate at once with the Secretary of the Alumni Association.

Anyone desiring rooms reserved for them should communicate as early as possible, with Louis Rossmann, 829 Park Ave., Baltimore, Md.

G. V. Milholland, treasurer, 507 N. Charles St.., Baltimore, Md., will be very glad to send membership cards to all who pay their membership dues.

NORVAL H. MCDONALD, *Secretary,*
904 N. Charles St., Baltimore, Md.

AN INVITATION FROM THE DENVER DENTAL ASSOCIATION

The Denver Dental Association extends to the Chicago dentists and all other eastern dentists a cordial invitation to stop over in Denver on their way to the National Dental Meeting at Los Angeles in July.

An early reply would be appreciated so that plans may be made for some entertainment.

A. C. HAMM, *President,*
724 Mack Bldg., Denver, Colo.

PRESENTATION OF GOLD MEDAL TO WILLIAM S. HALSTEAD

The National Dental Association, under the auspices of the Maryland State Dental Association, will present William S. Halsted with a gold medal in recognition of his original researches in neuro-regional and block anesthesia. The Maryland State Dental Association will give an honorary banquet on the evening of April 1, 1922, at the Belvidere Hotel, Baltimore, Maryland, at which time the medal will be presented. The program for the evening has been arranged by the committees, as follows: "Dr. Halsted as a Citizen," Frank J. Goodnow, president of Johns Hopkins University; "Dr. Halsted as a Teacher," H. E. Friesell, University of Pittsburgh; "Dr. Halsted as a Surgeon," Lewellys F. Barker, University of Maryland; "Dr. Halsted as a

Professor," J. M. T. Finney, Baltimore; "Dr. Halsted as a Research Worker," W. H. Welch, president, School Hygiene; "What Dr. Halsted Has Done for Dentistry, Oral Surgery, and Humanity," Arthur E. Smith, Chicago Graduate School of Dentistry; Presentation of the Gold Medal in Behalf of the National Dental Association, Otto U. King, Secretary-Editor of the National Dental Association.

A cordial invitation is extended to all members of the dental and medical professions. Banquet reservations may be secured by communicating with the chairman of the Local Committee. The committee is as follows: Lucien Brun, chairman, Clarence J. Grieves, Harry E. Kelsey, Ben J. Robinson, and James Ferguson.

In this testimonial banquet and the presentation of this gold medal, the National Dental Association is making a commendable effort to honor a scientist. Dr. Halsted has been a benefactor to dentistry and humanity; therefore let us honor him with our presence at this banquet.

National Dental Association Committee,
ARTHUR E. SMITH, *Chairman*,
KURT H. THOMA
THEODOR BLUM
THOMAS P. HINMAN

DENTAL CORPS ORDERS FROM WAR DEPARTMENT

NAVY

Lieutenant H. J. La Salle, marine guard, Peking.

Lieutenant (J. G.) R. D. Reid, to Beaver.

The temporary appointment as lieutenant commander of the following officers terminated December 31 and reverted to permanent status as lieutenant: Alfred W. Chandler, Thomas J. Daly, Rufus A. Ferguson, George M. Frazier, Richard C. Green, Alexander G. Lyle and Frank S. Tichy.—*Army and Navy Register*, January 28, 1922.

Lieutenant E. A. Jasper, R. S., San Francisco, Cal.: resignation accepted.

Lieutenant (J. G.) W. I. Minowitz, Public Health Service Hospital, Fort Lyon, Colo.; to Eagle 11.—*Army and Navy Register*, February 4, 1922.

Lieutenant H. R. McCleery, to marine barracks, Paris Island, S. C.—*Army and Navy Register*, February 11, 1922.

Litutenant E. A. Hyland, separate battalion of marines, Camaguey, Cuba; to Relief.

Lieutenant F. S. Tichy, Olongapo; to Cavite.

The following promotions in the Navy are announced: To be dental surgeons: William L. Darnell, Logan A. Willard, John V. McAlpin, Marson W. Mangold, Edward E. Harris, Anson F. McCreary, Hugh T. Meyers and Franklin L. Morey.

To be passed assistant dental surgeons: William R. Taylor, Hubert F. Delmore, John A. Walsh, Harrison B. Duncan, James C. Lough and Armin T. Fellows. To be captains: A. B. McCormick and C. C. Olson.—*Army and Navy Register*, February 18, 1922.

ARMY

Lieutenant Colonel Robert F. Patterson from temporary duty at general intermediate depot, Brooklyn, N. Y., and from duty at Camp Jackson, S. C., to Fort Benjamin Harrison, Ind., and report to commanding general 5th corps area for duty.—*Army and Navy Register*, January 28, 1922.

Captains Edwin M. Kennedy, Fort Logan, Colo., and Walter A. Rose, Jefferson Barracks, Mo., from duty at places indicated to Denver, Colo., Fitzsimons General Hospital for duty.—*Army and Navy Register*, February 4, 1922.

Captain Horace R. Finley from duty at Camp Jackson, S. C., effective upon the relief of 1st battalion, 6th inf., from duty at that station, and will accompany that organization to Camp McClellan, Ala., for duty.

Captain Jerome L. Fritsche from duties in Hawaiian Department, effective upon completion of present tour of foreign service and upon arrival in United States will report to commanding general, 9th corps area, San Francisco, for assignment to duty and station.

Captain Fletcher D. Rhodes from duties at Army and Navy General Hospital, Hot Springs, Ark., to San Francisco and about April 25 to Hawaiian Department for duty.—*Army and Navy Register*, February 11, 1922.

Major Charles C. Mann from Fort D. A. Russell, Wyo., to Fitzsimons General Hospital, Denver, Colo., for observation and treatment.

Capt. Campbell H. Glascock from duty at Camp Pike, Ark., to Hot Springs, Ark., Army and Navy General Hospital for duty.—*Army and Navy Register*, February 18, 1922.

List of applicants who have accepted appointments in the Dental Reserve Corps: First Lieutenant J. E. Wright, Ames, Iowa.

OFFICIAL SPECIAL TRAINS TO LOS ANGELES MEETING

For the accommodation of those attending the twenty-sixth annual meeting of our Association, the Transportation Committee has completed arrangements for the operation of two official special trains from Chicago, which will afford a choice of routes with a variety of entertainment and scenic points of interest en route.

Summer tourist tickets available for the Los Angeles meeting will be on sale daily May 15 to September 30, 1922, permitting stop-over at any point en route within final return limit of October 31, 1922. Fare from Chicago, going and returning via any of the southern or central routes will be $86.00. Going via southern and central routes, and returning via Portland, Seattle or Canada Pacific routes, or vice versa, will be $107.60. Tariffs from other points will be published as soon as available.

You will note from the following schedules that both trains will leave Chicago the same evening, arriving the same hour at Colorado Springs, where a most enjoyable day will be spent by the entire party.

The Special Train via Chicago & North Western-Union Pacific-Denver & Rio Grande to Colorado Springs, thence thru the Colorado Rockies and Salt Lake City will accommodate those who desire to travel via the Colorado Rockies and Salt Lake City direct to Los Angeles, or from Salt Lake City via San Francisco to Los Angeles.

SPECIAL TRAIN VIA THE CHICAGO AND NORTH WESTERN RAILWAY

(Sleepers ready 9:00 P. M. Sunday, July 9).

Lv. Chicago 12:15 A. M. (C. T.) Sunday, July 9, C. & N. W.
Ar. Omaha 1:45 P. M. (C. T.) Monday, July 10, C. &. N. W.
Lv. Omaha 2:00 P. M. (C. T.) Monday July 10, Union Pacific
Ar. Denver 4:00 A. M. (M. T.) Tuesday, July 11, Union Pacific
Lv. Denver 4:30 A. M. (M. T.) Tuesday, July 11, D. & R. G.
Ar. Colorado Srpings 7:00 A. M. (M. T.) Tuesday, July 11, D. & R. G.

(Day and evening to be spent in and around Colorado Springs, visit to Pikes Peak, Crystal Park Auto Trip, Cripple Creek, Manitou, Garden of the Gods, Cave of the Winds, etc.)

(Sleepers ready for occupancy 9:30 P. M.)

Lv. Colorado Springs 4:00 A. M. (M. T.) Wednesday, July 12, D. & R. G.
Ar. Royal Gorge 7:00 A. M. (M. T.) Wednesday July 12, D. & R. G.
Ar. Tennessee Pass 12:00 N'N (M. T.) Wednesday, July 12, D. & R. G.
Ar. Glenwood Springs 3:15 P. M. (M. T.) Wednesday, July 12, D. & R. G.
Ar. Salt Lake City 7:00 A. M. (M. T.) Thursday, July 13, D. & R. G.

(6 hours and 50 minutes stop-over at Salt Lake City)

Lv. Salt Lake City 2:50 P. M. (P. T.) Thursday, July 13, Union Pacific
Ar. Los Angeles 2:40 P. M. (P. T.) Friday, July 14, Union Pacific

Those who wish to travel via San Francisco will have four hours and forty minutes in Salt Lake City, leaving via Western Pacific Railroad on the following schedule for San Francisco:

Lv. Salt Lake City 12:40 P. M. (P. T.) Thursday, July 13, Western Pacific
Ar. Feather River Canyon 7:00 A. M. (P. T.) Friday, July 14, Western Pacific
Ar. San Francisco 6:00 P. M. (P. T.) Friday, July 14, Western Pacific

If rail line is desired between San Francisco and Los Angeles, the following train may be used:

Lv. San Francisco 8:00 P. M. (P. T.) Friday, July 14, Southern Pacific
Ar. Los Angeles 9:30 A. M. (P. T.) Saturday, July 15, Southern Pacific

Advanced information, descriptive literature and sleeping-car reservations may be secured by addressing H. G. Van Winkle, General Agent, Chicago and North Western Railway, 148 South Clark Street, Chicago, Ill.

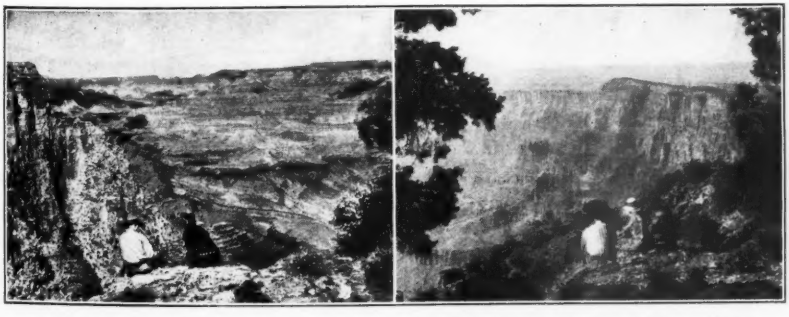
SPECIAL TRAIN SCHEDULE VIA ATCHISON, TOPEKA AND SANTA FE RAILWAY (SANTA FE)

Lv. Chicago	10:30 P. M.	Sunday, July 9.
Ar. Kansas City	10:40 A. M.	Monday, July, 10.
Lv. Kansas City	10:45 A. M.	Monday, July 10.
Ar. Colorado Springs	7:00 A. M.	Tuesday, July 11.
Lv. Colorado Springs	5:50 P. M.	Tuesday, July 11.
Ar. Santa Fe, N. M.	9:15 A. M.	Wednesday, July 12.
Lv. Santa Fe, N. M.	12:15 Noon	Wednesday, July 12.
Ar. Albuquerque	3:15 P. M.	Wednesday, July 12.
Lv. Albuquerque	4:35 P. M.	Wednesday, July 12.
Ar. Isleta	5:00 P. M.	Wednesday, July 12.
Lv. Isleta	6:00 P. M.	Wednesday, July 12.
Ar. Grand Canyon	7:00 A. M.	Thursday, July 13.
Lv. Grand Canyon	7:25 P. M.	Thursday, July 13.
Ar. Los Angeles	2:35 P. M.	Friday, July 14.

The sidetrip from Lamy to Santa Fe, N. M., and return is contingent upon a sufficient number for special train service. The balance of intinerary can be carried out for the actual number in the party.

A descriptive circular describing this trip has been prepared and may be had by addressing J. R. Moriarity, Division Passenger Agent, A. T. & S. Fe Ry., 179 W. Jackson Boulevard, Chicago, Ill.

D. C. BACON, *Chairman*,
31 N. State St. St., Chicago, Ill.



VIEW FROM LINCOLN POINT — THE PALISADES FROM DESERT VIEW

GRAND CANYON, NATIONAL PARK

PHILADELPHIA DENTAL COLLEGE

The Philadelphia Dental College will hold its annual alumni exercises, Wednesday, April 19. There will be a special reunion of classes 1872, 1877, 1882, 1887, 1892, 1897, 1902, 1905, 1907, 1912, 1917.

W. H. MAGANN,
1222 N. Eighteenth St., Philadelphia, Pa.

IN MEMORIAM: CLARENCE I. WILLIAMS

Clarence I. Williams, for over thirty years a practicing dentist of Terre Haute, Indiana, died suddenly in Cincinnati, Ohio, on Friday morning, January 6, 1922. Dr. Williams was born in Fayetteville, Indiana, September 6, 1868. When twelve years of age, with his father and mother, he moved to Sullivan, Indiana, where he lived for seven years. Then he came to Terre Haute, where he and his family have resided with the exception of the last year, which Dr. Williams spent in the West.

Dr. Williams received his high school education in Wiley High School in Terre Haute. Thirty-two years ago he graduated from Indiana Dental College and practiced dentistry here continuously with exception of last year when he was compelled to retire from active practice on account of ill health. Dr. Williams is survived by his widow, two daughters, and a son, his father, Captain I. C. Williams, three sisters and two brothers. Dr. Williams was an ardent Knight of Pythias, a member of the Terre Haute Lodge of Elks and of the various dental societies. He served several years as a member of the State Board of Dental Examiners, and was very active in all things pertaining to dentistry. Dr. Williams was always of a very kind and lovable disposition and will be deeply missed, not only by his immediate family but by all his friends and professional associates.

So the Terre Haute Dental Society extends their deepest sympathy to his family and friends.

RALPH A. SCHOTT,
M. BROWN,
B. B. WHITE,
VAN VALZAH,
C. E. IRWIN.